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THE THIRTY-NINTH YEARBOOK

OF THE
NATIONAL SOCIETY FOR THE STUDY
OF EDUCATION

INTELLIGENCE: ITS NATURE AND NURTURE PART II ORIGINAL STUDIES AND EXPERIMENTS

Prepared by the Society's Committee

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Edited by
GUY MONTROSE WHIPPLE

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TABLE OF CONTENTS

FOR

PART II. ORIGINAL STUDIES AND EXPERIMENTS

Page

OFFICERS OF THE SOCIETY FOR 1939-1940.....	iii
THE SOCIETY'S COMMITTEE ON "INTELLIGENCE: ITS NATURE AND NURTURE".....	iv
ASSOCIATED CONTRIBUTORS.....	v
EDITOR'S PREFACE.....	xvii
"INTRODUCTION".....	1

GEORGE D. STODDARD

Chapter

I. "A LONGITUDINAL STUDY OF THE EFFECTS OF NURSERY- SCHOOL TRAINING ON SUCCESSIVE INTELLIGENCE- TEST RATINGS".....	3
L. DEWEY ANDERSON	
I. Description of Samplings.....	3
II. The Testing Procedure in General.....	4
III. The First Part of the Study.....	5
IV. The Second Part of the Study.....	8
V. Summary and Conclusions.....	10
II. "MENTAL GROWTH IN YOUNG CHILDREN".....	11
NANCY BAYLEY	
I. The Consistency of Intelligence-Test Scores from Birth to Nine Years of Age.....	11
II. The Predictive Value of Four Different Meas- ures of Mental Development During the First Nine Years.....	31
III. "FACTORS INFLUENCING THE GROWTH OF INTELLIGENCE IN YOUNG CHILDREN".....	49
NANCY BAYLEY	
I. Health.....	49
II. Size and Body Proportions.....	51
III. Skeletal Maturity.....	52
IV. Socio-Economic Comparisons.....	54

V. Factors Influencing the Mental Growth of Various Selected Groups of Children.....	60
VI. Ratings of Attitudes toward Tests.....	61
VII. Records of Individual Children.....	67
VIII. Summary	75
IX. Conclusions	77
IV. "THE EFFECT OF NURSERY-SCHOOL ATTENDANCE UPON MENTAL GROWTH OF CHILDREN".....	81
GRACE E. BIRD	
V. "MENTAL AND PHYSICAL DEVELOPMENTAL PATTERNS OF IDENTICAL TWINS IN RELATION TO ORGANISMIC GROWTH THEORY"	85
BARBARA S. BURKS	
I. Subjects and Materials.....	86
II. Treatment of Data.....	87
III. Results	89
IV. Summary	96
VI. "A SECOND STUDY OF FAMILIAL RESEMBLANCE IN INTELLIGENCE: ENVIRONMENTAL AND GENETIC IMPLICATIONS OF PARENT-CHILD AND SIBLING CORRELATIONS IN THE TOTAL SAMPLE"	97
HERBERT S. CONRAD and HAROLD E. JONES	
I. Introduction	97
II. The Sample and the Data.....	99
III. Statistical Technique	104
IV. Presentation of Results.....	105
V. Interpretations	112
VI. Summary of Method, Results, and Interpretations	135
VII. "INFLUENCE OF THE NURSERY SCHOOL ON MENTAL GROWTH"	143
ARDEN FRANDSEN and FRANCES P. BARLOW	
I. The Nursery-School Group and the Control Group.....	143

<i>Chapter</i>	<i>Page</i>
II. The Statistical Results.....	146
III. Summary	147
VIII. "THE STABILITY OF MENTAL-GROWTH CAREERS".....	149
ARNOLD GESELL	
I. A Ten-Year Study in 'Prediction'.....	149
II. Illustrative Cases	152
III. Mental Defect in Infancy.....	158
IV. Developmental Endowment and Insurance Factors	159
IX. "THE MENTAL DEVELOPMENT OF NURSERY-SCHOOL CHILDREN COMPARED WITH THAT OF NON-NURSERY-SCHOOL CHILDREN"	161
FLORENCE L. GOODENOUGH and KATHARINE M. MAURER	
I. Subjects	161
II. Procedure	166
III. Results	168
IV. Discussion	176
X. "ADOPTED CHILDREN IN A PRIVATE SCHOOL".....	179
GERTRUDE HILDRETH	
XI. "AGE CHANGES IN THE RELATIONSHIP BETWEEN CERTAIN ENVIRONMENTAL VARIABLES AND CHILDREN'S INTELLIGENCE"	185
MARJORIE PYLES HONZIK	
I. Introduction	185
II. The Sample	186
III. The Data	188
IV. Results	190
V. Summary and Conclusion.....	203
XII. "MENTAL GROWTH AS RELATED TO NURSERY-SCHOOL ATTENDANCE"	207
HAROLD E. JONES and ADA P. JORGENSEN	
I. Groups I and IA.....	208
II. Groups II and IIA.....	210
III. Group III	213

<i>Chapter</i>	<i>Page</i>
IV. Control Group IIIA.....	215
V. Control Group IIIB.....	215
VI. Groups IIIC and IID.....	217
VII. The Relationship of Length of Attendance to Change in IQ.....	219
VIII. Summary.....	221
XIII. "INFLUENCING THE RATE OF MENTAL GROWTH IN RE- TARDED CHILDREN THROUGH ENVIRONMENTAL STIMU- LATION".....	223
NEWELL C. KEPHART	
I. Decline in IQ in the Home Environment.....	224
II. Effect of a More Favorable Environment upon the Downward Trend.....	227
III. Effect of a Specialized Program.....	228
IV. Conclusion.....	230
XIV. "A FOLLOW-UP STUDY OF A GROUP OF NURSERY-SCHOOL CHILDREN".....	231
EDNA E. LAMSON	
I. Purpose.....	231
II. Subjects.....	231
III. Data.....	232
IV. Summary.....	236
V. Conclusions.....	236
XV. "SUBSEQUENT GROWTH OF CHILDREN WITH AND WITHOUT NURSERY-SCHOOL EXPERIENCE".....	237
WILLARD C. OLSON and BYRON O. HUGHES	
I. Socio-Economic Selection.....	237
II. The Nursery-School Program.....	239
III. Records.....	239
IV. Uncontrolled Comparison of Growth of Nursery and Non-Nursery Children.....	240
V. Controlled Comparison of Growth of Nursery and Non-Nursery Children.....	240
VI. Length of Attendance and Subsequent Growth..	242
VII. Summary and Conclusions.....	244

<i>Chapter</i>	<i>Page</i>
XVI. "THE COURSE OF MENTAL DEVELOPMENT IN SLOW LEARNERS UNDER AN 'EXPERIENCE CURRICULUM' ".....	245
MIRIAM C. PRITCHARD, KATHRYN M. HORAN, and LETA S. HOLLINGWORTH	
I. Claims for a Carefully Planned Curriculum of Experiences	245
II. Organization and Aims of the Speyer School....	245
III. Plan of Experiment at Speyer School.....	247
IV. Data Secured in First Test and Second Test Compared with Data of Other Experimenters	248
V. Interpretations and Conclusions.....	253
XVII. "THE EFFECT OF A CHANGE TO A RELATIVELY SUPERIOR ENVIRONMENT UPON THE IQ'S OF ONE HUNDRED CHILDREN"	255
MARTIN L. REYMERT and RALPH T. HINTON, Jr.	
I. The Mooseheart Environment.....	256
II. Subjects and Material.....	258
III. Parental Background	259
IV. Results	260
V. Summary	266
VI. Conclusions	267
XVIII. "THE INTELLIGENCE OF SCOTTISH CHILDREN".....	269
ROBERT R. RUSK	
I. The 1932 Scottish Survey.....	269
II. The 1935-1937 Survey.....	270
III. Comparison of the Two Surveys.....	270
IV. The Average Intelligence Quotient.....	272
V. Rural and Urban Areas.....	272
VI. The Month of Birth.....	273
VII. The Form of the Distribution.....	273
XIX. "THE CUMULATIVE INFLUENCE ON INTELLIGENCE OF SOCIO-ECONOMIC DIFFERENTIALS OPERATING ON THE SAME CHILDREN OVER A PERIOD OF TEN YEARS"....	275
FRANK K. SHUTTLEWORTH	

<i>Chapter</i>	<i>Page</i>
XX. "SOME IOWA STUDIES OF THE MENTAL GROWTH OF CHILDREN IN RELATION TO DIFFERENTIALS OF THE ENVIRONMENT: A SUMMARY".....	281
HAROLD M. SKEELS	
I. Mental Growth in Relation to Length of Residence in Underprivileged Homes.....	282
II. Mental Growth in Relation to a Shift from an Inferior Home Environment to a Superior Adoptive Home Environment.....	286
III. Mental Development of Children Placed in Infancy in Above-Average and Superior Adoptive Homes.....	289
IV. Mental Growth in Relation to a Shift from a Relatively Non-stimulating Institutional Environment to One of More Marked Stimulation Value.....	296
V. Discussion of Criticisms.....	300
VI. Social Implications.....	305
XXI. "THE MENTAL DEVELOPMENT OF CHILDREN OF FEEBLE-MINDED AND NORMAL MOTHERS".....	309
GEORGE S. SPEER	
I. Subjects.....	310
II. Results.....	311
III. Summary and Conclusions.....	314
XXII. "IQ CHANGES OCCURRING DURING NURSERY-SCHOOL ATTENDANCE AT THE MERRILL-PALMER SCHOOL".....	315
ELIZABETH K. STARKWEATHER and KATHERINE E. ROBERTS	
I. Introduction.....	315
II. Purpose.....	316
III. Subjects.....	316
IV. Procedure.....	317
V. Results of Retests on Stanford-Binet and Merrill-Palmer Scales during Nursery-School Attendance.....	321

<i>Chapter</i>	<i>Page</i>
VI. Comparison of Woolley's Study with the Present Study	327
VII. Number of Days' Attendance and IQ Changes..	328
VIII. IQ Changes after Withdrawal from the Nursery School	330
IX. Summary of Results	335
XXIII. "THE MENTAL DEVELOPMENT OF CHILDREN OF FEEBLE-MINDED MOTHERS: A PRELIMINARY REPORT"	337
MARY ELIZABETH STIPPICH	
I. Criteria for Selection of Two Groups of Children.	337
II. The Children Themselves	338
III. The Mothers of the Children	339
IV. The Putative Fathers	340
V. The Boarding-Home and Institutional Place-ments	341
VI. Mental Development of the Children	342
VII. Summary and Conclusions	350
XXIV. "RETEST CHANGES IN THE IQ IN CERTAIN SUPERIOR SCHOOLS"	351
ROBERT L. THORNDIKE	
with the coöperation of	
CECILE WHITE FLEMMING, GERTRUDE HILDRETH, and	
MARGARET STANGER	
I. Retesting in the University of Iowa Schools. . .	351
II. General Conditions of Retesting in the Three Schools at New York	352
III. Analysis of Data Secured at New York	354
IV. Discussion	359
V. Summary	361
XXV. "DOES ATTENDANCE AT THE WINNETKA NURSERY SCHOOL TEND TO RAISE THE IQ?"	363
WILLIAM H. VOAS	
I. The Purpose of this Study	364
II. The Winnetka Nursery School	364
III. Results of Comparisons with Respect to Intelli-gence Quotients	366

<i>Chapter</i>	<i>Page</i>
IV. Results of Comparisons in Reading Achievement	371
V. Result of Comparisons in Emotionality	374
VI. Conclusions	376
XXVI. "IOWA STUDIES ON THE EFFECTS OF SCHOOLING"	377
BETH L. WELLMAN	
I. Purpose of this Chapter	377
II. Mental Growth during the Preschool Years	380
III. Mental Growth during the Elementary-School Years	392
IV. Mental Growth from Preschool to High School and College	395
V. Summary	397
XXVII. "A GENETIC STUDY OF FIFTY GIFTED CHILDREN"	401
PAUL WITTY	
I. Family Background	402
II. Physical Development	403
III. Intelligence	404
IV. Educational Achievement	405
V. Social Characteristics	407
VI. Summary	408
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Constitution of the National Society for the Study of Education . .	i
Minutes of the Cleveland Meeting of the Society	iii
Synopsis of the Proceedings of the Board of Directors	v
Report of the Treasurer	xi
List of the Members of the Society	xiii
Information Concerning the Society	
List of Publications of the Society	

EDITOR'S PREFACE

In 1922 the Society published the *Twenty-First Yearbook*, entitled "Intelligence Tests and Their Use," and in 1928, the *Twenty-Seventh Yearbook*, entitled "Nature and Nurture"; Part I, "Their Influence upon Intelligence," and Part II, "Their Influence upon Achievement." In other yearbooks, as, for example, those dealing with "The Measurement of Educational Products," "The Education of Gifted Children," "Adapting the Schools to Individual Differences," "Educational Diagnosis," "The Grouping of Pupils," and "Child Development and the Curriculum," more or less extensive discussion is to be found concerning the nature and use of tests of intelligence and concerning the relative contributions of heredity and of environment to the making of adult mentality. On these accounts, accordingly, the present yearbook is not a first excursion for this Society into a *terra incognita*, however obscure the terrain and its boundaries may appear to remain after the current volume has been exhaustively inspected for guidance.

More particularly this *Thirty-Ninth Yearbook* is to be regarded as sequential to the *Twenty-Seventh Yearbook*. Early in the discussion of it by the Board of Directors it was declared that this "Stoddard Yearbook" was intended to be "a more positive study" than the "Terman Yearbook," and "not so much a debate upon controversial issues as an exploration of possibilities." But yearbooks have a way of developing their own issues and of thrusting forward divergencies of procedure and interpretation that no keenly intelligent committee can evade without stultifying their professional consciences. It is the editor's impression at least that the discussion of nature and nurture in 1940 is just as controversial as it was in 1928 — more so, indeed. So much the more is credit due the Chairman and the members of the Committee for their very frank and straightforward criticism of one another's methods, results, and interpretations set forth without personalities or rancor. They have felt that the problems they were treating were of the utmost import not only for psychological theory but also for social and educational practice.

That leads me to say that when the Directors expressed the expectation that this Yearbook should take the form of "a more positive study" and an "exploration of possibilities," it was urged particularly

that there should be "a clear statement of the social implications of our present knowledge of nature and nurture," and that some space might well be devoted "to the implications for school organization." The Yearbook Committee will not need to invent reasons to explain why, in the text that follows, relatively little has been said, or at least said with unanimity, on these matters. At the second session of the forthcoming St. Louis meeting of the Society, an opportunity will be afforded, however, for exposition and discussion of these social and educational implications.

So far as the history of this Yearbook as an official undertaking of the Society is concerned, the topic was first proposed at our New Orleans meeting in February, 1937, when Dean Stoddard was appointed chairman and given a preliminary grant of \$600. By August of that year a Committee had been named, which, with two or three changes, became the official Committee of the Society. In 1938 there was granted \$500, and in 1939, \$400. The Chairman has held the Committee well to its work; the schedule has been followed punctually; the material reached the editor in uncommonly good form. The members of the Committee have shown a fine professional spirit; without disparaging any other members I think it not improper to say that Dr. Hollingworth must have devoted almost the last days of her life to perfecting her contributions to this volume, and that Dr. Terman made a, to him, arduous trip to a special Committee meeting at Chicago in order to secure a careful presentation of points of view that seemed to him cardinal.

This leads me to a final word on the contents of this *Thirty-Ninth Yearbook*. The treatment will seem ultra-technical to many readers not professionally concerned with the nature and investigation of intelligence. It is technical. The editor, at any rate, felt that not infrequently he had walked off the edge and was likely to become *spurlos versenkt*. There are two justifications that ought to be mentioned; one is that it is the proper function of this Society to devote an occasional yearbook to the more abstruse phases of educational thinking; another is that it is by no means unprofitable for the practical worker to peruse pages that he does not always understand, if only he reaps thereby the conviction that the fundamental and underlying truths about human nature are not so simple after all, either in their formulation or in their discovery.

G. M. Whipple, *Editor*

INTRODUCTION

GEORGE D. STODDARD

Chairman of the Committee

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Iowa City, Iowa

As stated in the Introduction to Part I of this Yearbook, expository material by Committee Members and their associates has been placed in the first part, while Part II, the present volume, has been reserved primarily for researches presented either in detail or as fairly substantial summaries of recent materials.

However the separate articles in Part II may be read independently, not only of related sections in Part I, but of each other. There has been no attempt on the part of the Committee to merge these and other materials into a single authoritative document. The order of presentation is alphabetical, by authors.

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CHAPTER I

A LONGITUDINAL STUDY OF THE EFFECTS OF NURSERY-SCHOOL TRAINING ON SUCCESSIVE INTELLIGENCE-TEST RATINGS

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The purpose of this study is to determine whether children who attend nursery school show significantly greater changes in IQ than those not attending such a school. The major contributions to date on this problem have been the publications from the Iowa Child Welfare Research Station (1, 3, 4, 5).¹ Briefly the conclusions of these studies are:

1. The average IQ of children tested after experience in a nursery school is higher than the average IQ achieved before that experience.
2. There is an increase in IQ on successive tests during nursery-school education; that is, nursery-school experience has a cumulative effect.
3. IQ increases are permanent. Children with nursery-school experience benefit in terms of increased IQ, and these benefits are lasting.

The present research was planned to verify these conclusions on another sampling of children in a different nursery school and was so arranged that the longitudinal research groups contained the same children over the preschool-age period, and that the same test was used before entrance into the nursery school, after entrance, and at the successive periods during the extent of the nursery-school training.

I. DESCRIPTION OF SAMPLINGS

The nursery-school children used in this study attended the Western Reserve Nursery School. These children and the non-nursery-school children used for controls were enrolled for serial examinations

¹See numbered references at the end of the chapter.

at the Developmental Health Inquiry. The average IQ's for all samplings at various examinations are given in the table of results and range between 112 and 125. With few exceptions socio-economic status of the parents fell in the first three groups of the Minnesota occupational classifications. All children were white and largely of North European stock.

The Western Reserve Nursery School was housed on the University campus in two adjoining attractive family residences with large, light, airy rooms. The daily session started at 9 in the morning and lasted until 3:30 each afternoon. The children lunched and took their after-lunch nap in the school. The teaching personnel consisted of well-trained teachers and student teachers from the School of Education of Western Reserve University. Play equipment was varied, of superior quality, and ample in amount. A considerable portion of the day was devoted to free play indoors and outdoors, but there were group activities also: luncheon, music, dancing, trips, and reading. The school was operated in accord with progressive methods of education, and there was little adult interference in the activities of the children. Both the breadth and amount of play equipment and group projects were conducive to providing a rich, stimulating environment. The opinion of visitors was consistent as to the high quality of this school in comparison with others in the country.

Staff meetings were held once a week at which individual problems were discussed. While the status of the intelligence-test results was used in these case discussions, the teachers did not use this information to plan individual programs for special cases. The psychological tests were given by a different organization and the examiners had no knowledge of the details of any child's nursery-school experience.

II. THE TESTING PROCEDURE IN GENERAL

The children enrolled in the Nursery School formed a part of a larger group of children being studied by the longitudinal method at the Developmental Health Inquiry. Psychological examinations are given at six-month intervals from 1 year to 5 years, and at yearly intervals thereafter. In most instances the children studied had had some nursery-school experience previous to the first psychological test.

The 1916 form of the Stanford-Binet was administered by trained psychologists as part of a psychological program directed by the writer.

III. THE FIRST PART OF THE STUDY

The purpose of the first phase of the study was to determine whether an increase in IQ occurs when the first test is given before any nursery-school attendance and the second test is given six months later, after attendance at the nursery school. Of the 135 children enrolled both in the Nursery School and also in the Developmental Health Inquiry series, 26 had had tests prior to their nursery-school experience. In nine of these cases the pretest was given at 2 or 2½ years of age. Because the Stanford-Binet test was not designed for children under 3 years of age, the data were treated in two ways; first, all 26 children were used; second, only the 17 children were used who had been given the first test at 3 years of age or later.

In the latter case each child in the nursery-school group was paired with a child without nursery-school experience in regard to IQ status at the first test, socio-economic status of parents, education of parents, and sex. In other words, all the variables thought to have an effect on the IQ were eliminated except *nursery-school experience* itself.

The raw data are given in Table I. The first column contains the code number of the pair; the second and third, the age at the first test (same for both groups); the fourth and fifth columns, the IQ ratings before and after nursery-school experience; and the seventh and eighth columns, the IQ ratings of the non-nursery-school group with testing periods comparable to those of the nursery-school group.

The following tabulation contains the average IQ for the different groups. The figures for the 26 nursery-school children indicate that

<i>Children</i>	<i>No Previous Nursery-School Experience</i>	<i>Nursery- School Experience</i>
26 nursery school	115.46	118.19
17 nursery school	117.18	119.59
17 non-nursery school paired with above*	117.29	116.06

*Same time interval between first and second test as in the case of the nursery-school group.

there was an increase of 2.63 points in the average IQ during the six-month period that embraced nursery-school experience.

The data for the two groups of 17 children each show the nursery-school group increased 2.41 IQ points in six months with some nursery-school education intervening, while, over the same time period, the non-nursery-school group lost 1.23 points. This increase of 2.41 divided by the standard deviation of the difference gives a critical ratio of 1.18. To be significant, this critical ratio would have to be 2.92 with 16 degrees of freedom.

Granting that there has been an increase, even though the statistical evidence does not safely permit such a conclusion, the cumulative data appear to indicate that there is no real or actual change in IQ itself, and that whatever slight increase occurs might be explained completely by such things as change in attitude toward games (tests), new adults in the environment, and familiarity with play material.

An analysis of variance, designed to determine whether the nursery and the non-nursery-school groups actually form a homogeneous or a heterogeneous population in terms of gains and losses was made by the method described by Snedecor (2) as follows: Since there were 34 children, 17 in each group, the total degrees of freedom are 33 and between groups, 1.

	<i>Degrees of Freedom</i>	<i>Sum of Squares</i>	<i>Mean Square Deviation</i>
Total	33	4324.24	131.04
Between groups	1	113.16	113.06
Within groups	32	4211.18	131.60

The results show that, in terms of gains and losses in IQ, the two groups (nursery-school and non-nursery-school) form a homogeneous population, since the variance within groups is larger than that between groups.

Finally, an analysis of Table I indicates that 7 of the 17 nursery-school children gained in IQ; 8 lost; and 2 made the same scores both times. Of the 17 non-nursery-school control group, 7 showed an increase; 9 a decrease; and one IQ remained the same.

The three analyses of the results indicate that nursery-school experience has had no specific effect on the IQ in terms of increase. There

TABLE I.—MENTAL STATUS OF NURSERY-SCHOOL AND NON-NURSERY-SCHOOL
PAIRED INDIVIDUALS OVER A SIX-MONTH PERIOD

(Nursery-School Group Had Training between Tests)

Code Num- ber, Pair	Age at First Test		IQ Nursery School			IQ Non-Nursery School		
	Years	Months	Before Nursery- School Experi- ence	After Nursery- School Experi- ence	Differ- ence	Corre- sponding to Column 3	Corre- sponding to Column 4	Differ- ence
1	2	—	108	100	— 8	*		
2	2	—	117	120	3	*		
3	2	—	139	139	0	*		
4	2	—	117	107	—10	*		
5	2	6	107	128	21	*		
6	2	6	113	117	4	*		
7	2	6	108	129	21	*		
8	2	6	108	106	— 2	*		
9	2	6	93	94	1	*		
10	3	—	115	125	10	117	95	—22
11	3	—	117	114	— 3	117	111	— 6
12	3	—	95	132	37	94	86	— 8
13	3	—	128	133	5	128	124	— 4
14	3	—	111	100	—11	111	114	3
15	3	—	127	119	— 8	128	105	—23
16	3	—	111	124	13	111	120	9
17	3	6	133	133	0	133	133	0
18	3	6	122	117	— 5	124	121	— 3
19	3	6	119	114	— 5	119	121	2
20	3	6	127	127	0	124	138	14
21	4	—	126	122	— 4	125	121	— 3
22	4	—	100	107	7	100	111	11
23	4	—	150	141	— 9	150	136	—14
24	4	—	86	96	10	88	104	16
25	4	—	125	122	— 3	125	133	8
26	4	—	100	107	7	100	111	11

*Asterisk in column 6 means "not paired."

is no evidence warranting the conclusion that nursery-school experience benefits some children and not others, since almost the exact characteristics are found in the non-nursery-school group.

IV. THE SECOND PART OF THE STUDY

The data just given answer the question for the groups studied as to the possible influence of nursery-school training at the early stages of such training. The next study was designed to determine whether there is a cumulative effect of nursery-school experience on the IQ. While it appears to be doubtful from the foregoing results that such could be the case, the writer felt that the data should be treated exhaustively. Specifically, the study is designed to determine whether the average IQ of nursery-school children increases directly with the amount of nursery-school experience.

Children having identical test data and nursery-school experience were placed in the four following experimental groups:

Nineteen children with 5 to 6 semesters of nursery-school training and with IQ rating at 3, $3\frac{1}{2}$, 4, $4\frac{1}{2}$, 5, and 6 years made up Group I. One to two semesters of training were characteristic of this group before the first test was given. (The question as to whether or not some nursery-school training took place before the first test is irrelevant here because our interest is in determining whether a progressive increase in IQ occurs.)

Twenty-five children with 3 to 4 semesters of nursery-school training, 11 of whom started the test program at 4 years, and 14 at $3\frac{1}{2}$ years made up the two Groups V and VII, respectively.

Twenty children, with 1 to 2 semesters of training, who started the test program at $3\frac{1}{2}$ years, formed Group III. This group is included as corroborative evidence, since in some cases all the nursery-school training may have taken place before the first test.

For each of these four experimental groups a control group was formed, by pairing each individual in the experimental group with one with no nursery-school training whatever, according to (a) IQ at five years, (b) socio-economic status of parents, (c) mid-education of parents, (d) sex. These are Group II, Group VI, Group VIII, and Group IV, respectively, in Table II.

A word of explanation is needed as to the use of the five-year IQ as the pairing criterion. Consideration of the data and the reliability of the Stanford-Binet test at the various preschool ages led to the conclusion that the five-year IQ was the most reliable. The only other possibility was to use an IQ before entrance to the nursery school. Even if tests had existed, their use would have been questionable because of the unreliability of the $2\frac{1}{2}$ - and 3-year Stanford-Binet scores.

If there is a cumulative effect of training, pairing in this way should result in an *increase in IQ* at successive ages up to five years for the *nursery-school group* and a *constant average IQ* for the *non-nursery-school group* throughout the age range studied, and a *lower average IQ* for the *nursery-school groups* than for the control groups under five years. The averages for the four experimental and the four control groups are given in Table II.

All the averages in this table are very similar to one another. Considering Nursery-School Group I, which had 5 to 6 semesters of training paralleling the testing experience, an increase from 113.5 at three years to 117.2 at five years is found, a gain of 3.7 points. However, the Control Group II (non-nursery-school children) rose from 113.47

TABLE II.—IQ AVERAGES FOR NURSERY- AND NON-NURSERY-SCHOOL GROUPS AT SIX TEST AGES, THREE TO SIX YEARS

Group	Semesters in Nursery		N	3	3½	4	4½	5	6
	School								
I	5 to 6	19	113.57	116.37	115.47	121.00	116.47	117.21	
II	None	19	113.47	112.95	114.89	115.89	115.89	118.05	
III	1 to 2	20		115.90	115.15	117.20	117.35	116.35	
IV	None	20		113.65	117.85	115.95	117.40	117.00	
V	3 to 4	11			121.82	120.36	119.00	116.18	
VI	None	11			119.73	118.91	119.18	114.27	
VII	3 to 4	14		122.50	123.60	122.93	126.14	122.14	
VIII	None	14		124.86	125.07	123.79	126.00	126.00	

(Nursery-school and non-nursery-school groups paired child by child at five years, according to IQ, parent education, socio-economic status, and sex.)

at three years to 115.89 at five years, a gain of 2.42 IQ points. The data for the other experimental and control groups present a similar picture of a small degree of change on successive examinations and no constant tendency for increase in IQ with increased nursery-school experience. Since there was no definite tendency for the average IQ to increase directly with amount of nursery-school experience, there was no point in calculating the significance of the slight differences found.

V. SUMMARY AND CONCLUSIONS

This study explores the possible effect of nursery-school experience on the IQ by determining whether with carefully selected groups of nursery-school and non-nursery-school children, there is evidence to substantiate the hypothesis that nursery-school training increases the IQ and that the amount of increase is dependent on the duration of such experience.

The results furnish no substantiation for this hypothesis. The data for the control and for the experimental groups, where individual children were matched according to IQ, socio-economic status, mid-education of parents and sex, present strikingly similar results. Neither in terms of an initial increase during the first few months of training nor in terms of an increasing amount of improvement according to the duration of nursery-school training does such training have any appreciable or constant effect.

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CHAPTER II

MENTAL GROWTH IN YOUNG CHILDREN¹

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I. THE CONSISTENCY OF INTELLIGENCE-TEST SCORES FROM BIRTH TO NINE YEARS OF AGE

1. The First Berkeley Growth Study: Antecedent Reports

In a cumulative study of growth and development at the Institute of Child Welfare of the University of California we have given mental tests at regular intervals to a group of 61 children from the time they were one month of age. Forty-eight of these children have been tested through 9 years. The tests have been given at 28 age levels; namely, every month at first, and as the children grew older, at three-month, six-month, and then twelve-month intervals. The testing procedures and results of the tests during the first three years have been described in detail in an earlier publication (3)² and will not be repeated here, except as they are included in the comparisons with data for the later ages.

It should be stated that the sample is, in some respects, above average; that is, the children's parents are on the whole a superior group in respect to education, occupation, and income, though there is a wide range in all three of these variables. As would be expected in such a socio-economic selection, the recent test results show that the children are for the most part above average in measured intelligence.

¹I wish to acknowledge my indebtedness to Dr. H. S. Conrad for valuable advice concerning statistical treatments and for critical reading of the manuscript. Assistance in the preparation of these materials was furnished by the personnel of Works Progress Administration Official Project No. 63-3-5406. Special acknowledgment is due to Mr. E. Brodene, draftsman.

²See numbered references at the end of the chapter.

Some degree of selection seemed to be unavoidable under the conditions of the study in which enrollment was voluntary and continued co-operation was important.

The study of the mental tests during the first three years showed, in brief, that the available tests of intelligence for infants and young children cannot be used for the purpose of predicting later ability. It appeared from the study that infants are variable in their rates of growth, and hence do not maintain the same relative position except over short intervals of time. An analysis of the data brought the further conclusions that:

. . . The longer the time interval between any two tests, the lower the correlation. There is, however, a tendency for scores to become more consistent as the children grow older.

The standard deviations of raw scores are very small at first, showing in general a tendency to increase with age. The one exception to this tendency, a sharp decrease between 6 and 12 months, coincides with other evidence that indicates a change in the functions measured before and after this period . . .

The findings show that the tests are measuring different functions, or groups of functions, at successive age levels, rather than, as has been often supposed, a unit function of intelligence that extends throughout life . . .

. . . The correlation between scores and education of the parents is negative in the first 7 months, then becomes zero, and in the second year grows increasingly positive, remaining in the third year between .41 and .50.

There was no evidence for a general factor of intelligence during the first 3 years, but the findings indicate, instead, a series of developing functions, or groups of functions, each growing out of, but not necessarily correlated with, previously matured behavior patterns. (3, pp. 83-85)

The present study is a continuation of this earlier one, and is based on the test scores of these same children at later ages. The scores they made from 4 to 9 years of age should serve, in part at least, to test the validity of the conclusions just quoted. From 3 through 5 years of age the mental-testing schedule consisted of the California Preschool Scale (11), administered every six months. This is the same test series on which the children had been tested since they were 18 months old. At

6 and at 7 years they were given the Stanford-Binet, and at 8 and at 9 years Form L of the new revision of the Stanford-Binet (14).¹ In presenting the statistics on these new data we include those for the earlier ages as well, in order to have a more complete picture of the entire nine-year span of development.

2. Statistical Descriptions of the Test Scores

The coefficients of reliability (split-half, corrected) of the tests after the first three months were found to compare favorably with tests used at later ages, especially when we consider the restricted age-range² (and consequently the restricted S.D.'s of scores) of the subjects at each age for which the correlations were computed.³ As our comparisons for consistency of developmental rate during the first year are based not on single-test scores, but on an average of three consecutive tests, we present here, for the first 15 months, the split-half reliabilities for the combined scores on three successive tests on the California First-Year Mental Scale (2). These reliabilities are somewhat higher than for the scores for single tests.⁴

Reliabilities for the Stanford-Binet at 72 and 84 months have been computed for purposes of comparison with those of the earlier scales. There appears to be little difference, in this respect, between the different scales.

In order to facilitate the use of combined scores, and to permit comparisons of relative ability at different ages, sigma scores were computed from the smoothed means and standard deviations of the group, for each child at each age tested. Wherever relative performances are compared (as in individual curves) or where scores for sev-

¹ Additional tests of mental development, which were started at 66 months of age, will be treated later in this chapter.

² During the first 15 months children were tested within one week of their birthday, usually within four days; during the second and third years they were tested within two weeks; and after this age, within one month. In so far as possible, tests have always been made within a few days of the birthday.

³ The means and standard deviations for the split-half tests from which the reliabilities were computed are closely similar.

⁴ The r 's for the three combined tests are computed from the sums of the raw scores. This procedure gives more weight to the later ages; so it is only approximate. For the split-half reliabilities for separate months the reader is referred to a previous publication of the author (2, p. 35).

eral ages have been combined, the test scores used in the following discussions are sigma scores computed from the (smoothed) means and standard deviations of the point scores of *this group of children*. Hence the growth-trends in ability for any given case are trends of that case in comparison with other children in this sample.

<i>Age in Months</i>	<i>Cases</i>	<i>r for Total Test</i>
<i>California First-Year Mental Scale</i>		
1, 2, 3	52	.84
4, 5, 6	54	.95
7, 8, 9	45	.94
10, 11, 12	50	.89
13, 14, 15*	45	.85
<i>California Preschool Scale, Form I</i>		
18*	51	.93
21	53	.83
24	48	.80
27	51	.88
30	47	.89
36	49	.84
42	43	.92
48	45	.94
54	44	.96
60	47	.95
<i>Stanford-Binet</i>		
72	48	.81
84	46	.91

* At 15 and 18 months there is some overlapping between the two scales, which are so constructed that scores may be computed on either scale.

It has already been mentioned that these children are, for the most part, a selected, above-average group. The medians, means, and stand-

ard deviations for their mental ages and IQ's on the Stanford-Binet are shown here:

<i>Months</i>	<i>N</i>	<i>Median</i>		<i>Mean</i>		<i>S. D.</i>	
		<i>MA</i>	<i>IQ</i>	<i>MA</i>	<i>IQ</i>	<i>MA</i>	<i>IQ</i>
72	48	88.9	123.0	88.9	123.3	11.2	15.6
84	46	106.0	126.3	103.6	123.0	12.5	15.1
96*	47	121.3	126.3	119.9	124.9	18.8	20.1
108*	45	143.7	133.7	139.2	129.0	23.3	22.2

* Form L of the new revision.

At 72 months only two children had IQ's below 100 and only one of these was below 90 (IQ of 69). At 84 months there were two with IQ's between 90 and 100, and one below this (IQ of 76). The new revision appears to cause a wider spread in scores, with standard deviations of 20 and 22 IQ points;¹ and although the means for Form L are higher, at 96 months ten of the children have IQ's below 100, with three of these below 90, and at 108 months four IQ's fall below 100, two of them between 70 and 80. The range is similar for all four ages.

Of course, when we consider the scores obtained here, we must bear in mind the fact that these children have had many previous testing experiences, with the same examiner. What is more, the examiner is acquainted with the children's interests and attitudes and can adapt her manner of presenting the tests to bring out each child's best efforts. The extent to which such factors have raised the children's IQ's cannot be determined, but it may be considered a constant environmental factor in the group.

The equality of testing experience, in conjunction with the large standard of deviation of performance and the fact that the same person has tested and scored their performance at all ages, should tend to increase the consistency of the scores made by these children from one age to the next (7).

3. Consistency of the Test Scores

a. Correlations. Table I gives the correlations between test scores, which are the average of three consecutive tests, for all ages from month

¹Terman and Merrill give a standard deviation on Form L for 11 years of 18 IQ points and for 12 years of 20 IQ points. Since the mental age of these children at eight years is 11 years, 4 months, we may assume that their variation is similar to that of the 204 eleven-year-olds on whom the tests were standardized.

TABLE II.—CORRELATIONS BETWEEN MENTAL-TEST POINT SCORES

Table II presents a similar set of r 's between tests given from 2 through 9 years, comparing single-test scores rather than combined ones. In this table the r 's show the same tendency to decrease in size with increasing time intervals between tests. Although this trend is not perfectly consistent, it is quite possible that with a larger sample it would be so. It is interesting to note that the shift from the California Preschool Scale to the Stanford-Binet results in no tendency for the r 's involving the two different scales to be lower than those in which both members of the correlation are based on the same testing scale.

The effect of age and interval on retest correlations is shown graphically in Figure I. It is evident from both the graphs and the

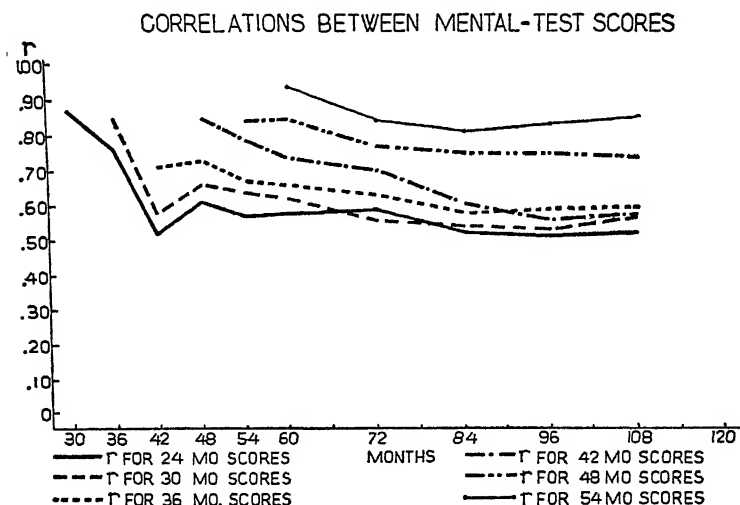


FIG. I.—CORRELATIONS OF MENTAL-TEST SCORES AT SIX AGES WITH TEST SCORES OBTAINED AT LATER AGES

tables that the children's rates of mental growth become much more stable around four years of age. Tests given at two and three years show a comparatively rapid drop in correlation with retests given before four years, but after this age the further drop is relatively slight. On the other hand, the r 's of the four-year and later tests show no marked drop in relationship but remain little changed over a period of several years. From these data it would appear that prediction in the grade school from tests given at four years of age may be possible

within wide classifications for most of the children ($r = \text{about } .75$). Tests given between 2 and 4 years will predict eight- and nine-year performance with less success ($r = \text{about } .55$), while scores made before 18 months are completely useless in the prediction of school-age abilities.

Another way of evaluating the predictability of test scores is by the use of Honzik's age ratio (10). Age ratios ($\frac{C A \text{ at Test 1}}{C A \text{ at Test 2}}$) were computed, from Table I, using the middle age of each age group, and the corresponding r 's were converted into their index of forecasting efficiency.¹ The coefficient of correlation between age ratio and index of forecasting efficiency, spread over an age range of from birth to 7 years, is .95. The scattergram is slightly curvilinear. Age ratio and index of forecasting efficiency as computed from Table II correlate .82 for the age-range 2 to 9 years. These r 's are in close agreement with Honzik's, and support her suggestion that the constancy of test performance is directly related to the age of testing and inversely related to the time elapsed after a given test. The age ratios, however, tend to obscure a tendency shown in the charts for the length of the interval between tests to be of considerably less significance at the later ages. A more detailed analysis of these facts may be presented at a later time.

b. Changes in IQ Points. One of the most frequent methods of comparing test-retest scores to determine constancy of the IQ is to find the number of points the IQ has changed at the second test as compared with the first. IQ's have not been computed for the earlier ages, but the Stanford-Binet IQ's are available for 4 ages, and the changes between these tests are given in Table III.

The IQ changes evidenced by these children are of particular interest because the children have all had a high degree of testing experience under relatively constant conditions. Because such experiences should reduce spurious variations to a minimum, smaller than usual IQ changes might be expected. Actually, the changes seem, in many respects, to be similar to those of other studies. There appear to be slightly greater changes between the old Stanford and the new revision

¹ $1 - \sqrt{1 - r^2}$. Cf. C. L. Hull. *Aptitude Testing*. (World Book Co.; Yonkers, N. Y., 1928) 268 pp.

TABLE III.—CHANGES IN IQ POINTS ON SUCCESSIVE TESTS

<i>Months between Which Scores Are Compared</i>	<i>Number</i>	<i>Mean</i>	<i>Median</i>	<i>Q₁</i>	<i>Q₂</i>
CHANGE REGARDLESS OF SIGN					
<i>One-Year Interval</i>					
72 and 84	45	5.78	4.8	1.87	8.87
84 and 96	44	7.81	6.6	1.95	11.95
96 and 108	45	7.40	5.6	2.58	10.25
<i>Two-Year Interval</i>					
72 and 96	46	8.82	8.0	3.70	11.81
84 and 108	44	11.83	10.45	2.58	10.25
<i>Three-Year Interval</i>					
72 and 108	44	11.59	10.62	5.15	16.75
CHANGE INVOLVING INCREASE IN IQ					
<i>One-Year Interval</i>					
72 and 84	21	6.72	6.2	2.9	10.85
84 and 96	22	9.86	9.3	3.2	13.45
96 and 108	25	10.24	8.3	5.13	16.88
<i>Two-Year Interval</i>					
72 and 96	29	9.09	7.8	4.2	11.85
84 and 108	28	14.45	14.45	8.83	18.20
<i>Three-Year Interval</i>					
72 and 108	32	12.64	11.28	5.95	17.95
CHANGE INVOLVING DECREASE IN IQ					
<i>One-Year Interval</i>					
72 and 84	23	5.06	4.6	1.46	8.16
84 and 96	22	5.59	4.0	.74	7.70
96 and 108	17	4.53	4.0	1.63	6.25
<i>Two-Year Interval</i>					
72 and 96	17	8.36	8.3	3.20	11.70
84 and 108	16	6.27	6.95	2.15	12.15
<i>Three-Year Interval</i>					
72 and 108	12	8.70	7.95	2.95	15.95

(84 to 96 months) than between the ages at which the same form of the test was given (72 to 84, and 96 to 108 months). Also, the effect of time is apparent, as the average changes over the two- and three-year intervals are greater than over the one-year intervals. From one point of view these findings might be considered as further verification of the constancy of the IQ. However, for those who are concerned with the development of individual children, it seems an important fact that a fourth of the group change 10 or more IQ points on retests made one year after the initial test; while an equal number change 17 or more IQ points over a three-year interval.

The gains are at all ages larger than the losses, and they increase in amount as the children grow older (or perhaps one should say, as they have more experience with the tests). Although approximately as many children lost as gained on the second and third tests after intervals of one year, more children gained on the fourth test, and over the longer intervals. Familiarity with the tests has evidently kept some children from falling behind in their scores as far as they might have on a first test, and has perhaps been operative in bringing about a larger proportion of gains in IQ. When the amount of change in IQ from one test to a later one is plotted against IQ at the first test, the scatters show no significant relation between IQ and stability of scores. It is possible that this lack of a relation, which other investigators have reported (12), is a function of the generally above-average sample. If so, it is of course also possible that, if there were more dull and retarded children in the group, the average changes in IQ points would be smaller for the same intervals.

4. Individual Trends of Growth

We turn now from coefficients of correlation to a study of individual trends in mental scores. These trends could be presented in several ways. We shall consider here individual curves of sigma scores, in which a child is compared at successive ages with the mean of the group. A child's fluctuations in sigma scores will be indicative of his own variations in rate of growth as compared with the central tendency of this group of children.

The individual curves of sigma scores in Figures II to VII give the curves for all 48 children who completed eight years in the study.

The curves show very few children maintaining an even approximately constant relation to the average of the group: the eight cases in Figure II were selected for their consistently average trend; and

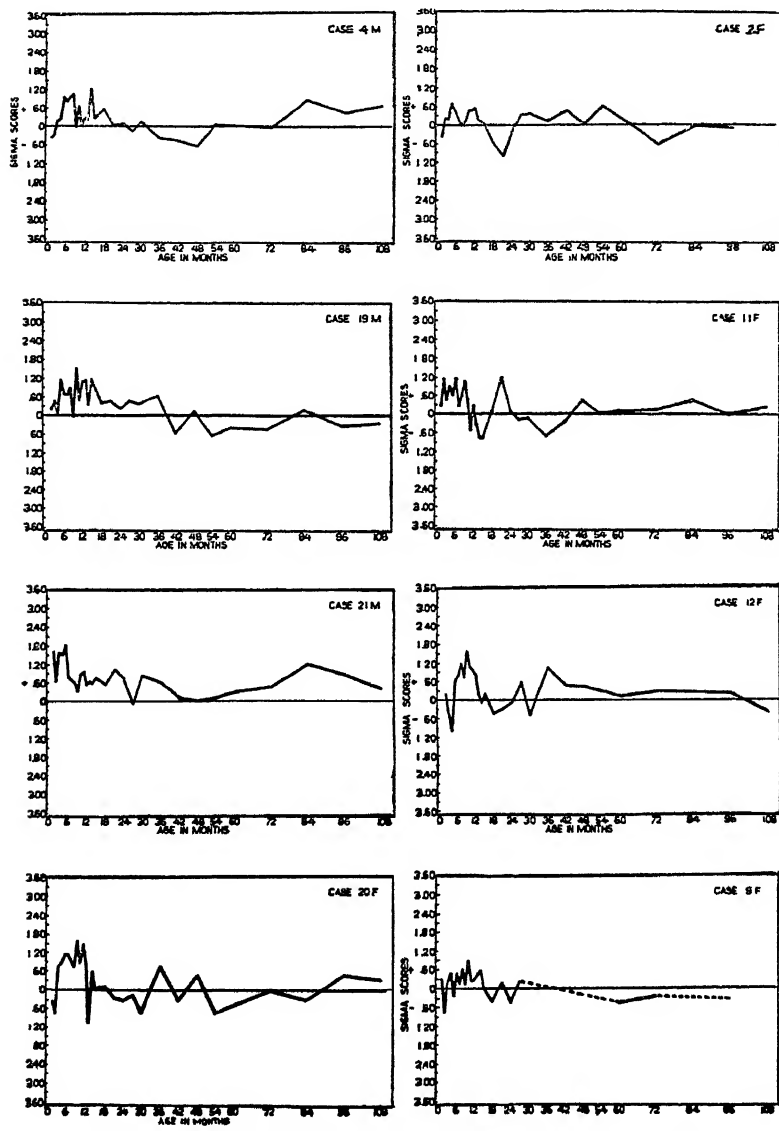


FIG. II.—CASES MAINTAINING SCORES NEAR THE AVERAGE

several others, especially in Figure VII, are close to the average or maintain fairly consistent positions above or below the mean. In general, however, rates of development as measured are individual and fluctuating. Most of the children have periods in which there is a trend toward relatively rapid or relatively slow growth. Although there are minor fluctuations, due in part to incomplete reliability of measurement,¹ adjacent tests usually yield similar scores: it is over the longer age intervals that the scores fall into a pattern of wider fluctuations or trends in rate of growth.

These trends are very different for different children; some show an almost continuous drop in their relative position — a proportionately slow rate of development after birth, whatever their status at the time of birth. Examples of this tendency are given in Figure III. Cases 20M, 13M, and 8M (all boys) show the most strikingly slow rates of growth over most of the age span considered. However, even here the rate is not consistent over the entire age range. Case 8M had an early spurt of rapid development, whereas the other two cases appear to be speeding up somewhat in the later years. Other cases in Figure III show less marked and less consistent trends.

In Figure IV are the cases with most continuously rapid growth; they rise to ever higher positions in the group as they grow older. Perhaps the most striking of these are Cases 5M and 7F. Many of the curves fluctuate, showing alternating periods of slow and rapid growth.

Cases in Figure V exhibit, more or less clearly, slow early growth followed by rapid growth, whereas cases in Figure VI developed rapidly at early ages and more slowly later. But for some of these children such a statement is too general, because within this age range there may be several periods of alternating slow and rapid development. The tempo of these cycles is also an individual matter for each child, and is not, even for the same individual, a regular or constant rhythm. In all the groupings in these five figures, a few cases fit well, while others are less clear-cut, and some are rather forced. Figure VII contains miscellaneous cases in which the curves cannot be fitted into any of the

¹Small fluctuations in the curves would be ruled out to some extent if the norms had been based on a large number of cases and if the tests were so constituted as to prevent spurious changes in standard deviation at different ages. Both of these sources of error have been partially compensated for by the use of smoothed means and standard deviations in the computation of sigma scores (except in the case of the Stanford-Binet scores).

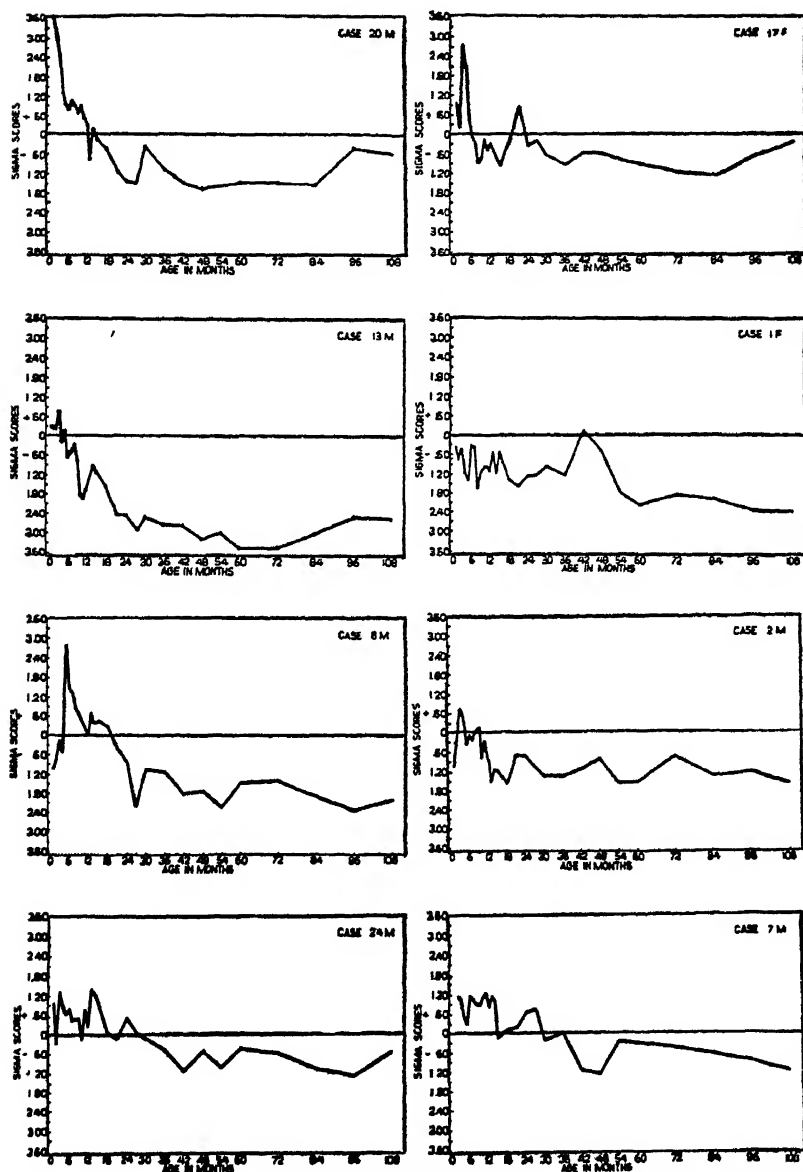


FIG. III.—CASES WITH RELATIVELY SLOW RATES OF DEVELOPMENT

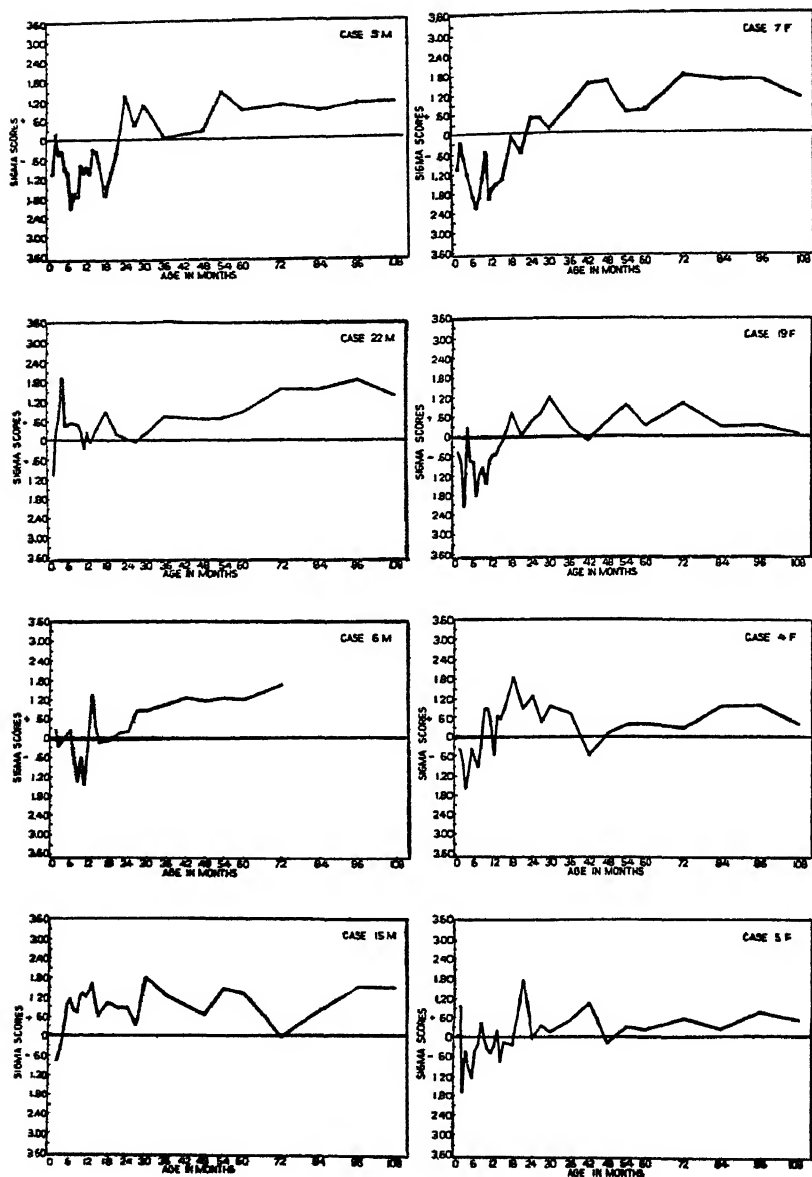


FIG. IV.—CASES WITH RAPID DEVELOPMENT

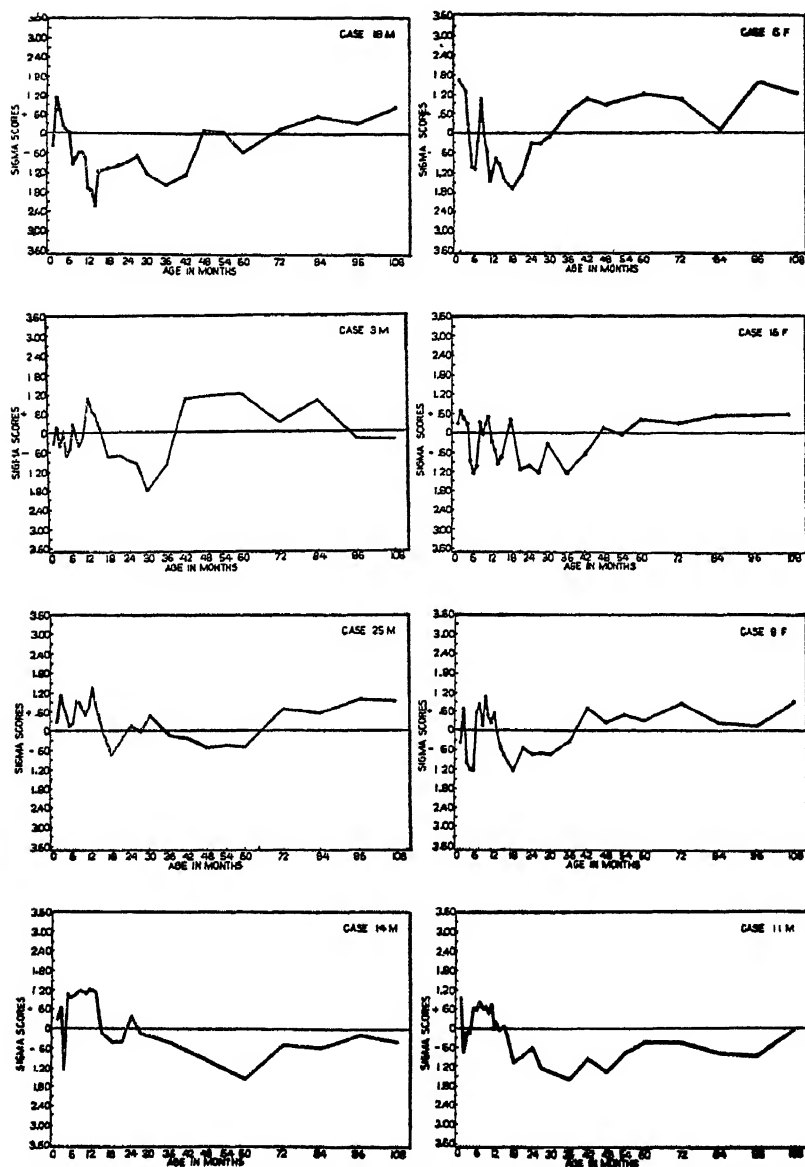


FIG. V.—EARLY SLOW DEVELOPMENT WITH SUBSEQUENT RAPID GROWTH

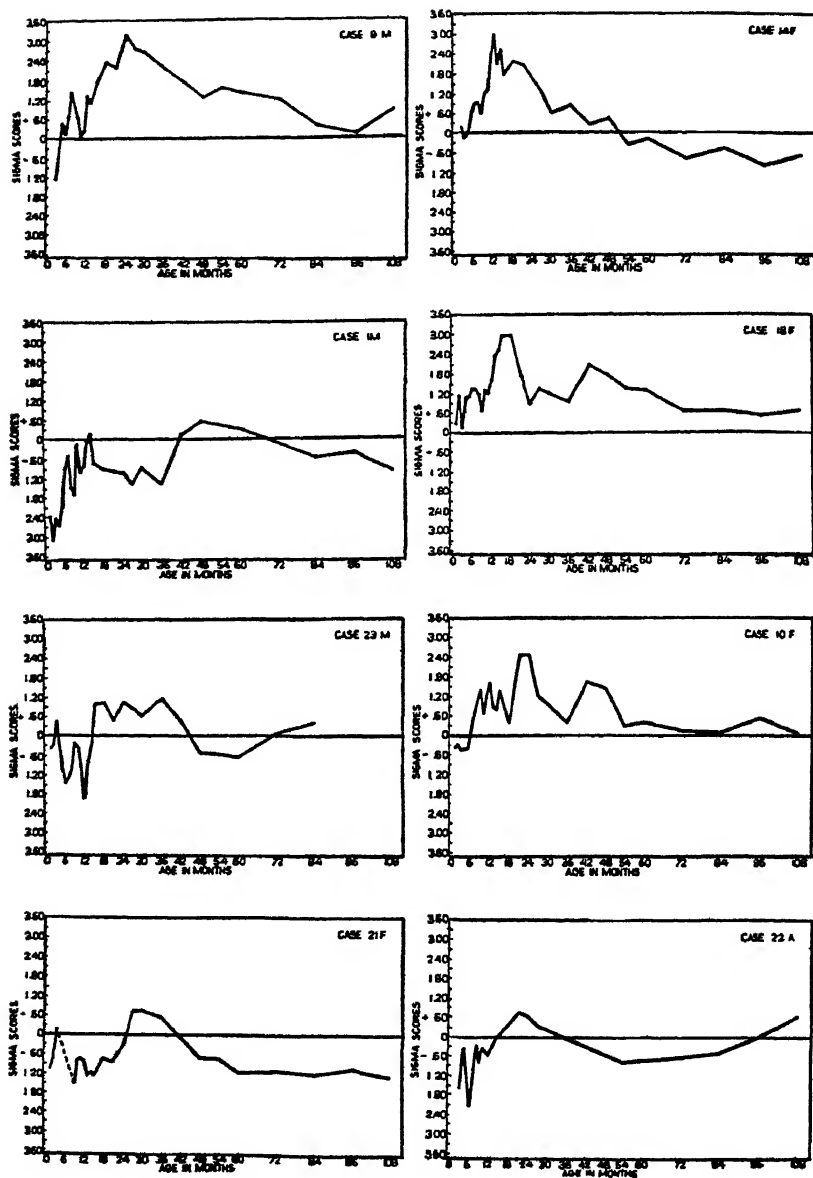


FIG. VI.—EARLY RAPID DEVELOPMENT FOLLOWED BY SLOWER GROWTH

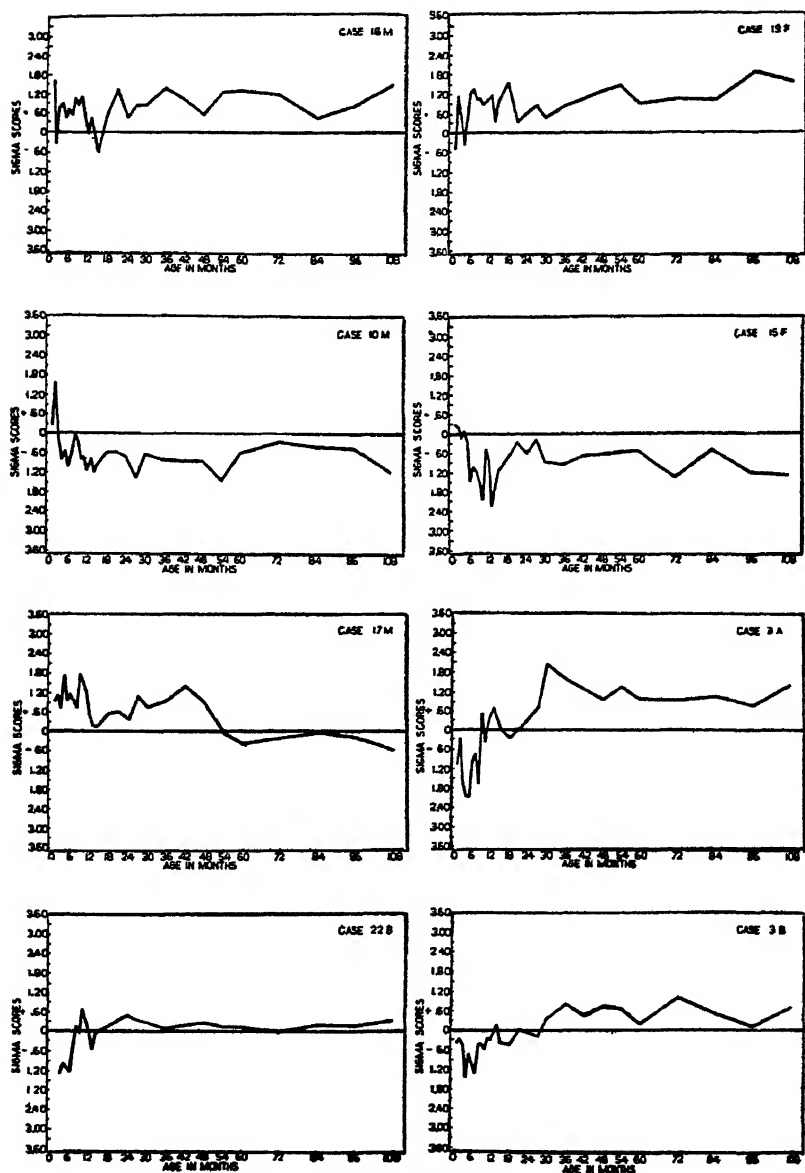


FIG. VII.—MISCELLANEOUS CURVES

foregoing classes; it also contains the curves of two twin pairs, which were placed together for comparison with each other. Although there are only two pairs of twins and nothing conclusive can be determined from them, it is interesting to note that the amount of similarity of the curves is in the expected direction. Cases 22A (Figure VI) and 22B (Figure VII) are monozygotic girls, and their curves are very similar. Cases 3A and 3B (Figure VII), on the other hand, are dizygotic girls who are very dissimilar in body build and general physical appearance. Although both of these curves show early rapid growth and later above-average scores the change is far more marked in one than in the other.

If the attempt is made to divide the curves according to superior, average, and inferior ability, perhaps ten or a dozen can be found that are at most ages about average. Two or three (for example, Cases 16M and 13F in Figure VII) are rather consistently somewhat above average, and another two or three (for example, Cases 10M and 15F) are rather consistently a little below. But when it comes to the extremes of superior and inferior cases, we find less stability. If we select the children who made the highest scores at one month and at six months, and at one year and at two years (Cases 20M, 8M, 14F, and 9M), we find that these high scores were for these children high points in their development — the highest sigma scores they ever made, and positions from which they rapidly slipped back toward the mean. Those with top scores at the later ages show less spectacular shifts, and are more likely to maintain a superior status over a period of years. Examples of these are Cases 7F (highest at six and seven years) and 13F (highest at eight and nine years). Case 9M, although he recedes rapidly from his high point at two years, is still the highest in the group at three and again at five years.

In the same way, if we select those with the lowest scores at one month, at six months, and at one year (Cases 1M, 22A, and 23M), we see that we have selected low points for these cases and that their scores also rapidly regress toward the mean. Case 13M becomes the most retarded at two years and remains so for the later ages. Although one child maintains the lowest score from two years of age, if he were eliminated, several different children would be lowest at successive ages. In general, we again find greater stability in the scores of the relatively retarded children after two years of age.

Inspection of the individual curves leads to the conclusion that rates of intellectual growth tend to become more stable between two and four years of age; some children settle into a consistent rate of growth earlier than others. The more stable cases are usually those making scores near the average of the group. Cases selected because of their extreme scores at any one age are unlikely to maintain that position at other ages. There is, during the first two years, a strong tendency for these cases to regress toward the mean. The extreme scores may be due in part to unreliability of measurement, but the fact that the tests prior to and succeeding them build up to, and then recede from, these points makes it seem very probable that they do represent periods when these children deviated more than usual from the rest of the group because of lags or spurts in their development.

5. Summary and Conclusions with Respect to Consistency of Intelligence Scores, with Some Hypothetical Explanations

The rates in mental development of 61 children from one month to nine years of age as measured by a series of mental tests have been found to be irregular. During the first 18 months or 2 years, when rates of growth are rapid and variability of scores is small, the relative position of a child in respect to others in the group is very unstable. As rates of growth decrease and as standard deviations of scores increase, the children's growth becomes more constant and therefore more predictable. This trend is shown in the correlations between tests at various ages, and very strikingly in the individual curves of children's relative (sigma) scores.

Changes in Stanford-Binet IQ points from 6 to 9 years of age also show shifting rates of growth, with larger changes over longer intervals, and with 25 percent of the children changing 10 or more IQ points on retests after one year, and 17 or more IQ points on retests after three years.

In this somewhat superior group the most stable children appear to be those who maintain scores near the group average. There is a strong tendency for children who make extreme scores to regress toward the mean, especially at the younger ages.¹

¹ The fact that the most outstanding exception to this is a retarded case may be significant, as he may be representative of children with low IQ's. It is noteworthy, however, that his later retarded status could not have been predicted from his scores during the first two years.

The fact that the IQ is not constant in young children has been well established by a number of recent studies. The data presented here show the ages at which a certain amount of stability may be expected; that is, after age four, intelligence tests may have some practical use for prediction over periods of a few years at least. The trends of the scores for these children point toward fairly stable growth for most of the children up to adolescence or beyond. However, other studies of older children (9, 12, 15) would lead us to expect throughout childhood some continued variation in rates of mental growth.

There are four hypotheses that may be used to explain the variable rates of mental development in children. First, is the hypothesis that 'intelligence' is fundamentally innate, but that its growth is irregular because it is the resultant of numerous functions that develop both concomitantly and successively, each growing out of previously established abilities but developing in its own way. As a result mental organization changes as new components develop and as older matured ones cease to play an important rôle in differentiating abilities in all except cases of extreme retardation.

Second, an alternative explanation is that, although inherently stable, intelligence as measured is inconstant because the composition of the tests varies, stressing different abilities at different ages. On this hypothesis it is assumed that if only adequate tests could be invented, intelligence would be found to develop consistently, because it is a unit factor. Or, perhaps, there is a core that is a unit factor, 'g,' which theoretically can be isolated from other specific factors, and this 'g' develops consistently.

Third, if neither of these is true, then we must fall back on the third hypothesis that if intelligence is native and is a unit factor that increases in efficiency throughout childhood, then the rate of increase cannot be predicted because it is variable, for some unknown reason, with periods of rapid and slow growth alternating at unpredictable intervals.

Fourth, opposed to these assumptions that intelligence is innate is the hypothesis that variations in rates of mental growth are the result of differing environmental influences, either beneficial or detrimental, which act on the growing organism differently at different stages of its development.

The first three of these hypotheses are mutually exclusive in so far as a central factor of general intelligence is concerned. But the

fourth may operate in conjunction with any of the others. However, the multiplicity of factors involved makes it exceedingly difficult, if not impossible, to determine exactly the relative importance of innate and environmental influences.

The data presented here can give us only hints as to the correct hypothesis. The complete lack of correlation between scores made during the first nine months and those made at four years and later make the second hypothesis seem very doubtful. In regard to the fourth (environmental), it may be pointed out that scores become relatively stable before the children are subjected to the levelling experience of similar school environments, and that entrance into school does not markedly disturb the trends previously evidenced. What is more, although all of the children had the same high degree of practice in test procedures, this practice has not resulted in any tendency for test scores to become more alike. If environment is operative in changing these children's scores, it is to be looked for in the wide diversity of home backgrounds and opportunities for stimulating experiences, or in accidents of health or disease.

As for the two remaining hypothesis — our first and our third — although either may be used to explain the individual curves of growth on the mental tests as given here, the analysis of the data in the study of the first three years (3) gave considerable evidence in favor of the first; that is, it seems more likely that intelligence is composed of many factors and that these factors do not all start with the child at birth but may appear successively and develop at independent rates.

In the following report a study will be made of several different measures of mental growth and of various combinations of test items in an attempt to find some more stable aspects of intelligence. This study should throw some additional light on the validity of the second hypothesis. A further study will be concerned with environmental and other factors that may affect, or be related to, rates of mental development.

II. THE PREDICTIVE VALUE OF FOUR DIFFERENT MEASURES OF MENTAL DEVELOPMENT DURING THE FIRST NINE YEARS

In the first part of this study rates of growth in intelligence from birth to nine years for individual children were found to be irregular and widely dissimilar. The children were measured at successive ages

by a series of tests of general mental ability. The tests used were the California First-Year Mental Scale (2), The California Preschool Scale, Form A (11), the Stanford Revision of the Binet Tests and Form L of the new Stanford Revision (14). It has seemed possible that greater consistency in scores might be found if other measures of ability were used; or if the items tested were combined in different ways or were selected to measure more nearly homogeneous functions. Here, accordingly, we are concerned with attempts to find some measures of intelligence, verbal, nonverbal, or both, that would yield this greater consistency.

1. Mental and Motor Tests Combined: Developmental Scores

Because many of the scales of mental development for infants have included performances in such motor abilities as sitting, creeping, and walking, and because some investigators, using such scales, have claimed that they could predict later developmental status, it has seemed advisable to make some comparisons using a combined motor- and mental-test score. The California Infant Scale of Motor Development given to these children has been described elsewhere (2, 5). It is comprised of items involving motor coördinations and skills common to infants. These motor tests were given to the children at the same testing period as the mental tests, usually as soon as the mental test was finished, and they entered into them eagerly. Correlations between the motor-test scores at different ages are all positive, but they are low, except between tests given at adjacent test intervals, whence it has been concluded that prediction from scores on the motor tests was possible for only very short intervals (5).

For the purposes of the present comparison, the point scores of the motor scale have been added to the point scores of the California First-Year and Preschool Mental Scales to obtain a combined score for each child. This procedure gives more weight to the mental scales, as there are approximately twice as many items at each stage in these scales as there are in the motor scale. Although other infant scales also have comparatively few items of gross motor coördinations, the proportions may not be the same for all ages as in the test used here, and will be found, of course, to vary with the different scales. For convenience we shall follow the practice of other investigators and call this more inclusive group of behaviors a Developmental Scale. De-

developmental scores were computed at twelve ages, from one month through 36 months.

The scores made on the Developmental Scale at several age levels have been correlated with each other and with mental scores at the five-, six-, and seven-year levels to show consistency of relative performance. These r 's are given in Table IV, which also includes, for purposes of comparison, the mental test r 's for the same age intervals. It is clear that prediction either within this scale or with later mental achievement has not been appreciably altered, and certainly not improved, by using this more inclusive measure of abilities for the first three years.

TABLE IV.—CORRELATIONS FOR CONSISTENCY OF DEVELOPMENTAL TEST SCORES

<i>Average Score in Months</i>	<i>Average Scores in Months</i>				
	<i>1, 2, and 3</i>	<i>4, 5, and 6</i>	<i>10, 11, and 12</i>	<i>27, 30, and 36</i>	<i>60, 72, and 84</i>
1, 2, and 3		.59	.26	.04	— .08
4, 5, and 6	.57		.55	.27	— .04
10, 11, and 12	.28	.52		.57	.12
27, 30, and 36	— .09	.10	.45		
60, 72, and 84	— .13	— .07	.20	.70	

(Correlations at the lower left are mental-test r 's shown here for convenience of comparison. The cases number 48 to 61. In the last column the developmental score has been correlated with the average mental score for 5, 6, and 7 years.)

2. A Selection of Six Categories from California Preschool Scale, Form A

The inclusion of a wider variety of performance has failed to increase prediction in scores, but perhaps we may fare better with a restricted group of items. In the earlier study (3) a selection of what appeared to be the more 'intellectual' items for the first three years failed to yield better prediction. However, this *a priori* method of selection is only one way of dividing the items. A statistical method might prove more fruitful. We have available such a selection, starting with the two-year tests. By calculation of the beta-coefficients

in the standard multiple regression equation (13), Miss Gertrude Cox found that four of the ten categories of tests in the Preschool Scale contributed considerably less than the others to the total mental score.¹ Eliminating these four categories, the scores made by the Growth Study children were computed, using only the items in Categories IV, V, VII, VIII, IX, and X.² This procedure of course, shortened the test, and for this reason probably reduced the reliability of the scale somewhat, but on the other hand we should expect that the validity of the instrument would be increased. The scores for the short scale were correlated with the scores made by the children on a composite of the four discarded categories³ at months 24, 36, and 60. The r 's between these two parts of the scale are .52, .55, and .79 respectively. Although there is a definite relation between the two sets of scores, the r 's are all lower than those between the two equally divided (reliability) halves of the total test, which are .67, .73 and .90 for the same ages. By eliminating those items whose scores seem to depend largely on manipulatory skills, it may be that in the remaining six categories we are measuring a more nearly homogeneous set of functions than in the total test. The correlations for consistency for this selected test series are given in Table V. Comparison with the r 's in Table II, shown on page 16, for the same ages and intervals shows that in 13 instances the r 's have been increased; in three they remained the same; in eight they have dropped. This selection of categories appears to have improved prediction for the lower more than for the higher age levels of the test. None of the differences is very great, but it seems probable that a scale made up of these and similar items, if increased in length to equal that of the total test, would be a definite improvement as an instrument for measuring intellectual abilities. However, in spite of this greater homogeneity of the tests, we find the same tendency for the correlations to drop as the intervals between tests increase and as the

¹ An unpublished study made in a collaboration with Dr. Adele S. Jaffa on the California Preschool Scale (11).

² The nature of the tests may be indicated roughly by the titles of the categories: IV, Form Discrimination; V, Discrimination of Spatial Relations; VII, Language Comprehension; VIII, Language Facility; IX, Immediate Recall; and X, Completions.

³ I, Manual Facility; II, Block-Building; III, Drawing; and VI, Size and Number Discrimination.

age at testing decreases. If this shortened scale is a more valid measure of mental ability than the longer one, we have even more valid evidence that the intelligence of individual children does not grow with regularity or consistency over long periods of time.

TABLE V.—CORRELATIONS SHOWING THE CONSISTENCY OF PARTIAL SCORES FROM CALIFORNIA PRESCHOOL SCALE I

<i>Months</i>	<i>Months</i>						
	<i>24</i>	<i>30</i>	<i>36</i>	<i>48</i>	<i>60</i>	<i>84</i>	<i>96</i>
21	.74	.62	.65	.56	.51	.38	.38
24		.73	.76	.66	.66	.57	.53
30			.76	.66	.72	.65	.55
36				.73	.75	.60	.60
42				.84	.72	.65	.63
48					.81	.69	.69
60						.82	.79

(The scores for the 84th and 96th months are the Stanford-Binet IQ.)

3. Vocabulary Scores

Perhaps prediction over a longer period would be better if we restricted the nature of the tests even further to a single type of ability, such as language. We are able to make the comparison with vocabulary scores for several ages. At 78 and at 90 months these children were given an adaptation¹ of the vocabulary test from the Thorndike CAVD scale, Levels E through H. At months 72, 84, 96, and 108 the vocabulary in the Stanford-Binet was administered as a part of the mental test. For comparison with language abilities at earlier ages, scores on the Action-Agent Test at 36 and 42 months have been taken from the preschool scale. In addition, we have the age at which each child first said two words. These various measures give us a series of scores of vocabulary, or language ability, starting with the age of first talking, early in the second year, through the Action-Agent Tests (around three years), and including scores on two standard vocabulary

¹ As the children could not read, Levels F, G, and H were given orally, and only half of the items in each of these three levels were used. Level E was not used at 90 months.

tests from 6 through 9 years of age. We have compared the scores obtained on these tests with each other and with the total mental-test scores at different ages.

The six sets of vocabulary scores, which were given within a period of approximately three years, have fairly high intercorrelations. These are given in the following tabulation:

<i>Months</i>	<i>78</i>	<i>84</i>	<i>90</i>	<i>96</i>	<i>108</i>
<i>72</i>	.72	.80	.74	.73	.70
<i>78</i>		.68	.72	.61	.65
<i>84</i>			.69	.73	.78
<i>90</i>				.66	.67
<i>96</i>					.86

In general, the r 's tend to be higher between retests on the same scale. But whether we consider all of the scores or only those for the Stanford-Binet Vocabulary there is only a slight tendency for lower r 's between the longer retest intervals. At these ages the mental-test scores show the same high consistency over a three-year period; hence, we cannot say that vocabulary is any more stable than a battery of tests at this

TABLE VI.—CORRELATIONS OF VOCABULARY SCORES WITH
MENTAL-TEST SCORES

<i>Total Mental-Test Scores at Months</i>	<i>Vocabulary Scores at Months</i>			
	<i>72</i>	<i>78</i>	<i>84</i>	<i>90</i>
<i>6</i>	— .12	.08	— .25	— .03
<i>12</i>	.16	.24	— .04	.26
<i>24</i>	.41	.34	.37	.56
<i>48</i>	.63	.61	.56	.73
<i>60</i>	.67	.65	.70	.79
<i>72</i>	.77	.70	.76	.83
<i>96</i>	.76	.60	.77	.77

(The vocabulary scores were obtained at 72, 78, 84, and 90 months, using the modified Thorndike Scale at 78 and 90 months; the mental-test scores at 6, 12, 24, 48, 60, 72, and 96 months. The correlation .77 at 72 months is spuriously high because the vocabulary score is a part of the total mental-test score at that age.)

level. The vocabulary scores for four successive tests have been correlated with the mental-test scores at seven ages (Table VI). When we consider the r 's with the mental tests near the ages at which the vocabulary tests were given, we see that they are for the most part between .70 and .80. But as the age at the mental test becomes younger the correlations drop markedly, showing the same trends that were found for the total mental-test scores. It still remains to determine whether this lack of consistency is inherent in all mental performances, or whether a test of language ability at the earlier ages would be more closely related to later language scores. The scores on the Action-Agent Test at 36 and at 42 months have been used in the hope of de-

TABLE VII.—CORRELATIONS BETWEEN ACTION-AGENT TEST
AND VOCABULARY SCORES

Vocabulary Scores		Action-Agent Test			
Age in Months	Scale	Month 36		Month 42	
		Num- ber	r	Num- ber	r
72	Stanford-Binet	46	.44	42	.71
78	Thorndike	38	.52	36	.68
84	Stanford-Binet	43	.36	39	.66
90	Thorndike	43	.55	39	.72
96	Stanford-Binet	45	.43	41	.65
108	Stanford-Binet	44	.37	40	.58

ciding this issue. The scores on this test for the two ages correlate .66 (the mental-test r between these ages is .71). The correlations with the vocabulary scores are given in Table VII. These r 's are all positive but moderate, ranging from .36 to .72 and averaging .45 for the 36-month scores and .67 for the 42-month scores. They are for the most part lower than the retest r 's between the vocabulary scores over shorter intervals, with the 42-month r 's higher than the 36-month r 's. For both ages the r 's of Action-Agent with the Stanford-Binet Vocabulary tend to drop with increasing intervals between tests. The reverse is true, on the other hand, for r 's with the two testings on the Thorndike Scale. However, the 90-month Thorndike test in general shows higher relations with other abilities than does the 78-month test; it appears, therefore, that the later test of vocabulary is a more accurate measure

of the children's abilities.¹ Action-Agent correlations with mental-test scores are as follows:

<i>Age at Mental Test, Months</i>	<i>Action-Agent at Month 42</i>	
	<i>N</i>	<i>r</i>
6	40	— .06
12	42	.28
72	42	.75
96	41	.63

These show the usual tendency for low relation between first-year and subsequent scores, with definite positive relation only when the scores are based on tests at later ages.

The age of first talking (that is, the age at which a child first said two words) gives us our earliest score of vocabulary. The average age of its occurrence in this group of children is at 13 months; the range, from 9 to 21 months. We see from the following tabulation that the age of first talking is not significantly related to mental-test scores

<i>Mental Test at Months</i>	<i>Cases</i>	<i>r</i>
4, 5, 6	52	— .13
7, 8, 9	53	— .30
10, 11, 12	53	— .54
18, 21, 24	53	— .45
27, 30, 36	52	— .50
42, 48, 54	46	— .46
60	47	— .44
72	45	— .25
84	43	— .26
96	46	— .21

either in the early months before the children talked or after five years of age. The relation is marked only at the time when this ability was first achieved and during the four years following it. That is, the

¹ At 90-month, level E (picture vocabulary) was omitted and thus the test was made purely verbal.

age at which a child talked was related to his other manifestations of intelligence at the same and similar ages; but the age of talking could not have been predicted at 7 or 8 months of age from his mental-test scores, nor could the age of talking predict the general level of mental ability after five years of age. The trend of these correlations is shown also in Figure VIII.

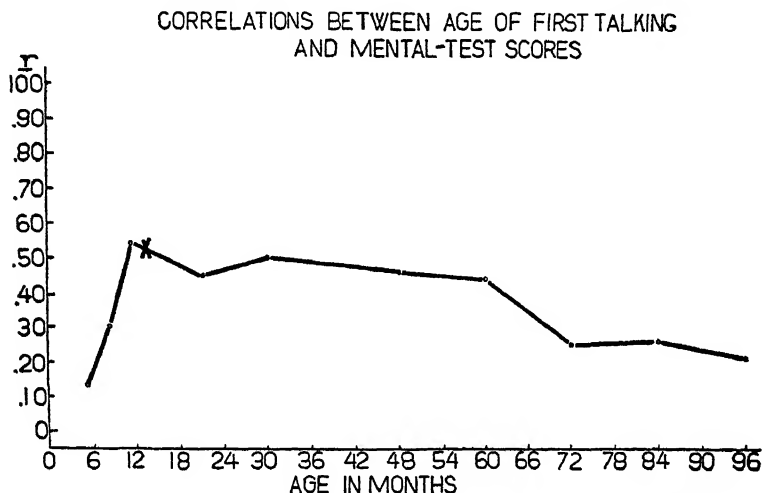


FIG. VIII.—CORRELATIONS BETWEEN AGE OF FIRST TALKING AND MENTAL-TEST SCORES AT EARLIER AND LATER AGES

The age of talking is moderately related to scores on the Action-Agent Test: at 36 months the r is .44; at 42 months, .40. These coefficients are similar to those for total mental-test scores between the same ages. When we compare the longer intervals again, we find that the age of first talking correlates with the Stanford-Binet Vocabulary at 72 months only .23, and with the modified Thorndike at 78 months, to the amount of .11. According to these findings, precocious talking is hardly indicative of a subsequent large vocabulary, and (for this sample, at least) vocabularies appear to be little, if any, more stable than other manifestations of intelligence in very young children.

4. Formboard Performance

What consistency of performance may we find in a test of non-language ability? We have, for our sample, some evidence on this

from the five-figure, the two-figure, and the casuist formboards given at 66 and 78 months, and from the Dearborn puzzle-board given at 90 and 102 months. In all these tests the children made scores averag-

TABLE VIII.—MEDIAN, MEANS, AND STANDARD DEVIATIONS OF PERFORMANCE-TEST SCORES: FORMBOARDS AND PUZZLE-BOARDS

	<i>N</i>	<i>Mdn.</i>	<i>M</i>	<i>S.D.</i>		<i>N</i>	<i>Mdn.</i>	<i>M</i>	<i>S.D.</i>
<i>Month 66</i>					<i>Month 78</i>				
<i>Formboard, Arthur Point-Scores</i>									
Five-figure	46		0.73	1.24	41		1.69	1.06	
Two-figure	46		1.86	1.04	41		2.18	1.10	
Casuist	44		2.30	1.24	41		3.41	1.15	
Total	44		4.90	2.60	41		7.20	2.67	
<i>Month 90</i>					<i>Month 102</i>				
<i>Dearborn Puzzle-Board: Moves</i>									
Puzzle A	46	5.58	7.04	4.75	44	5.72	6.09	1.81	
Puzzle B	46	12.17	14.67	7.30	44	11.00	12.02	2.70	
Puzzle C	46	14.23	15.46	7.06	44	12.50	14.70	6.28	
Total Moves	46	33.50	37.22	13.71	44	29.95	32.82	7.91	
<i>Month 90</i>					<i>Month 102</i>				
<i>Dearborn-Puzzle Board: Time</i>									
Puzzle A	46	57.67	83.17	69.60	44	55.17	64.86	38.47	
Puzzle B	46	93.86	128.83	89.00	44	66.50	72.64	31.06	
Puzzle C	46	104.33	129.70	83.24	44	88.13	99.55	55.59	
Total Time	46	326.00	339.59	158.20	44	223.50	237.14	81.66	

ing from one to four years above their age norms as given by Arthur (1) and by Dearborn (8) (Table VIII). Although they show the same tendency to be superior, the scores¹ for the formboards and puzzle-board are very inconsistent in comparison with the other mental-test

¹ The scores on the formboards are total scores for all three boards, each having been scored according to Arthur's table of point scores (1).

The scores used for the Dearborn board are the sum of the moves for all three puzzles. If a puzzle was not completed in five minutes, a score of 35 was counted for that puzzle. Time scores were discarded in the comparisons with other data, because time alone, and time and moves combined, were somewhat less closely related to the 96-month Stanford-Binet (Table IX).

data. Scores made on the formboards one year apart correlate .59, and scores made on the puzzle-board, also a year apart, correlate only .44. Performances of this type appear to be of considerably less predictive value (possibly because of lower reliability) than measures of vocabulary. In both of the formboard series, but especially in the Dearborn board, the first administration of that particular test is clearly more significantly related to other kinds of achievement than is a subsequent administration. The children gave every appearance in their behavior of not remembering the solution after the lapse of a

TABLE IX.—CORRELATIONS BETWEEN DEARBORN PUZZLE-BOARD SCORES AND MENTAL-TEST SCORES

<i>Mental Score at Month</i>	<i>90 Months</i>		<i>102 Months</i>	
	<i>N</i>	<i>r</i>	<i>N</i>	<i>r</i>
<i>Dearborn Board, Moves</i>				
6	43	.03	40	.002
12	44	.15	42	— .11
24	41	.52	39	.26
48	42	.49	41	.26
72	45	.58	43	.47
96	45	.55	44	.40
<i>Dearborn Board, Time</i>				
96	45	.47	44	.22
<i>Dearborn Board, Time and Moves</i>				
96			44	.36

(The scores have been adjusted to make the *r*'s positive when a high score on the mental test, in points, corresponds to a superior score on the formboard, in moves and time.)

year, yet there may have been more carry-over for some children than for others, to that extent changing the character of the task. Typical drops in the value of *r* in the case of the Dearborn board from administration at 90 months to administration at 102 months are .53 to .29, .51 to .33, .43 to .29. These are *r*'s in the vocabulary. The less discriminating character (and one reason for the lower *r*'s obtained) of the Dearborn puzzles at the second administration is shown by the reduced standard deviations presented in Table VIII. In both time and moves the reduction at the later age is almost to half of what it was at the earlier age.

One must assume from the comparisons (that just made, the one following, and that in Table IX) of r 's with scores made at first and at second testings, either (a) that the repeat formboard tests have little validity as measures of intellectual ability, or (b) that tests of this nature are of value only during the ages when the tasks set are definite challenges to the children's ability to solve them at all. If the latter is

<i>Mental Score at Month</i>	<i>Formboard Score at Month 66</i>		<i>Formboard Score at Month 78</i>	
	<i>N</i>	<i>r</i>	<i>N</i>	<i>r</i>
6	40	— .08	37	.16
12	43	.34	39	.45
24	41	.66	36	.40
48	42	.62	37	.60
60	43	.74	40	.61
72	44	.63	39	.42
96	42	.60	40	.46

true, the ages at which we first used these sets of boards are already near the upper limit of their useful functioning for this sample. Had this precocity been anticipated, the tests might have been administered at an earlier age. In all probability, however, the first solution of such puzzles is a better test of intelligence. In any event, the first solution yields higher r 's in our data, and will be given more weight in comparisons made with other scores.

Both the formboards and the puzzle-board yield scores positively correlated with mental-test and vocabulary performance at similar ages. (See the tabulations and Table IX.) But, again, the r 's drop when the comparisons are with mental tests under two years of age. The 6-month mental test, which has a reliability coefficient of .95, correlates practically zero in all four comparisons with the formboard and puzzle-board tests. At 12 months, though still low, the r 's are higher with the formboard than with the puzzle-board scores, possibly because of the difference in age intervals between the tests compared.

5. Comparison of Findings and Conclusions

In the first section of this report four hypotheses were given as alternative explanations of the variable rates of mental growth in indi-

vidual children. The analysis of the children's mental-test curves did not support (though it did not actually disprove) the third hypothesis that intelligence is a unit factor that, unaccountably, grows at varying rates. Neither were the trends of the curves in accordance with the fourth hypothesis, that environmental influences are strongly operative in differentiating this group of children. In an earlier study (3) the first hypothesis was offered to explain the children's uneven development; namely, that what we call intelligence is a multiplicity of functions developing more or less independently and at different stages in the developmental process. The evidence in the first section of this study could support either this, or the second hypothesis (of consistently developing intelligence that would be found if only there were tests adequate to measure it). Let us examine the evidence from the data presented here in the light of these hypotheses.

These investigations have most bearing on the first two hypotheses, and they agree in discrediting the second in favor of the first. It is possible, of course, that tests might be devised for use in infancy that would predict later intelligence. But the present efforts have been fruitless. Neither a more widely inclusive measure of the development of behavior nor various selections restricting the nature of the abilities measured has yielded greater prediction from the first two years.

But perhaps the *measures* are not really consistent at all ages. Such an hypothesis as the second can hardly be disproved because it is always possible that two tests that appear objectively to be the same or similar may actually require different functions for their solution at different levels of difficulty. It seems obvious in the block-building series, for example, that the initial stages, which require insight into the processes of putting one block on top of another and then letting go of it while it is still there, are very different from the muscular control and persistence required for stacking eight blocks on top of one another; and these in turn are different from the ability to see the relation of the separate blocks to the whole structure when the child tries to copy the five-block 'gate,' or to reproduce the stairs from memory. Perhaps there are similar but less obvious differences in the functions measured by the tests of vocabulary at different ages. The question here is whether it is in the very nature of intelligence that these functions differ at different ages, or whether similar functions

are present at all ages — though still not isolated in such a way that they can be compared.

It seems more reasonable to conclude (in accordance with the first hypothesis) that there is a pervasive change in mental organization during the early preschool period. Such changes may well account for the variable rates of development indicated in the curves of individual children presented in the first section.

The scores on vocabulary and on formboards indicate, as was suggested above, that even these are not simple unitary functions. In Figure IX the relations between total mental scores and two widely

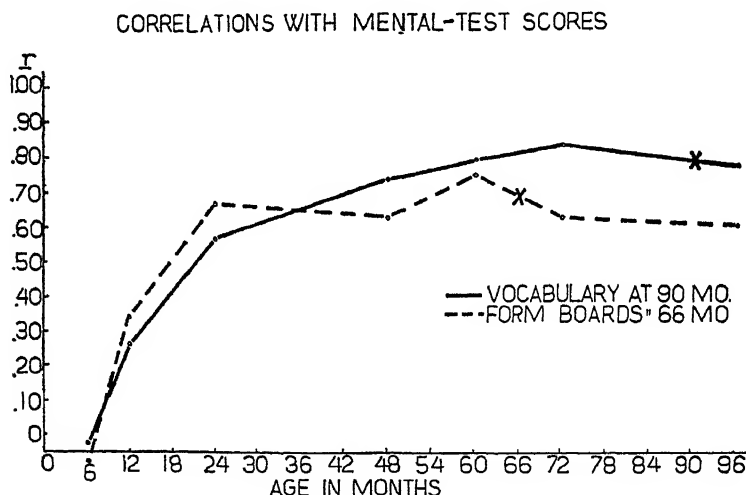


FIG. IX.—CORRELATIONS BETWEEN MENTAL-TEST SCORES AT SUCCESSIVE AGES AND TWO MORE SPECIFIC TYPES OF BEHAVIOR: FORMBOARDS AT 66 MONTHS AND VOCABULARY AT 90 MONTHS

different kinds of ability are compared. Using as axes the size of correlation and age, we have plotted the r 's of mental scores at several ages with the formboard scores at 66 months, and with the vocabulary scores at 90 months. The two resulting curves are remarkably similar in their trend. It becomes obvious that neither the verbal nor the non-verbal performances of these children after two years of age are related to their mental scores earned during the first year. The break is very marked for both curves, and is also to be seen in Figure I, and in all

of the tables here presented of relationships between earlier and later developing abilities, whatever their nature.

These changes in the nature of developing mental functions appear to be most rapid between one and two years of age. Also in keeping with these findings are those reported in a previous study on motor development (4). The r 's between the motor-test and mental-test scores are approximately .5 during the first 15 months and then suddenly drop to around .2 and remain so for the later ages. It is at about this age too, that the children's mental-test scores become positively related to their parents' education (6).

It has been suggested repeatedly that this break occurs at about the time language is acquired, and that it may be due to the increasing importance language plays in intelligence-test scores. Our data on the non-language performance tests, however, show the same evidence for a change in relationships within that field. What is more, the children's scores in vocabulary, from the age of first talking through the Action-Agent to later vocabulary tests, vary over long intervals in the same way as they do in the total mental test. Language cannot be the only factor that makes for poor prediction of mental-test scores from earlier to later ages, because language ability itself is unpredictable.

Nor can environmental influences (the fourth hypothesis) be considered, from these data, as paramount in determining changes in abilities. The inconsistency of scores before and after two years is as pronounced for formboard performances (in which the children were equally untrained) as for vocabularies (the specific contents of which were obviously learned).

It seems, nevertheless, improbable that this group of children is entirely unlike other children on whom the effects of environment have been reported, and we may expect that differences in environmental opportunity *do* influence these innate processes of growth. In a previous study (6) these children's scores were shown to be definitely related, after two years of age, to several socio-economic factors. Of course, the coincidence of these factors does not permit us to determine whether environment is to any extent a causal influence or whether innate ability becomes similar to its adult form only after the period of infancy. A more detailed study of individual children may help us to answer this question.

6. Summary of Predictive Value of Four Different Types of Measures

In an attempt to find some measure of mental ability that would rate children consistently during the first nine years, several combinations of scores were studied.

(1) A 'Developmental Score' made up of the sum of the items of the separate mental and motor tests yielded no greater consistency than did the mental test alone.

(2) A selection of items from the California Preschool Mental Scale improved slightly the correlations of the two- and three-year tests with later performance, but the improvement was not great enough to produce constant scores over four or five years.

(3) Tests of vocabulary given at from six to nine years of age gave scores moderately related to language tests at three and three and a half years, and were not significantly related to the age of first talking or to early mental-test scores.

(4) Tests of formboard and puzzle-board performance (at five and a half to eight and a half years), although related to mental-test and vocabulary scores at similar ages, were unrelated to tests of ability during the first year.

It was concluded that mental organization changes with growth, and that the rate of change is especially rapid before two years of age.

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CHAPTER III

FACTORS INFLUENCING THE GROWTH OF INTELLIGENCE IN YOUNG CHILDREN¹

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Previous reports have revealed irregularities in the growth of mental abilities in early childhood (4). In the preceding chapter a variety of growth patterns, not all marked by consistency in rate, was shown in the age curves achieved by individual children. It was also shown to be impossible to isolate any type of behavior that shows a greater consistency than is found for the composite mental test. The next logical step is to inquire into the factors influencing these variations in rates of growth. In the following report, a study will be made of available data on health, size and body proportions, skeletal maturity, socio-economic factors, nursery-school attendance, family constellation, and emotional factors. A consideration of these in relation to mental scores at successive ages may throw some light on the relative rôles of nature and nurture in mental development.

I. HEALTH

We may consider first the children's health and the history of their illnesses. Routine physical examinations, in which the physician made ratings of nutrition, development, and handicaps to physical well-being, were made at 21 months, 36 months, and once a year thereafter. These ratings were combined to form an eighteen-point scale. On this scale the health ratings ranged from 1 (excellent) to 16, with a standard deviation of about 3 points. The mean tends at all ages to be around 7, indicating, in general, 'slightly better than average health' according to the physicians' estimates.

¹ Acknowledgment is due to the Social Science Research Council for a grant to Dr. Harold E. Jones, making possible the collection of additional socio-economic data. Dr. Pearl Bretnall and Mrs. Jean Carter assisted in data collection. Assistance in the preparation of the materials was furnished by the personnel of Works Progress Administration Official Project No. 63-3-5406.

At each visit the mother was asked about the child's health since the previous visit, and all the reported illnesses and present evidences of illnesses were recorded. These data are available from birth through six years. From these records scores for the number of illnesses, roughly weighted (on a five-point scale) by their severity, have been computed for two age-intervals, birth to three years, and birth to six years.

If we assume that repeated and severe illnesses would have a depressing effect on children's mental growth, then we should expect that a cumulative score that included all a child's illnesses would be negatively related to mental-test scores. As we see in the following tabulation, there is no relation between the children's illnesses for their

	<i>Mental Score at Month</i>			
	<i>21</i>	<i>36</i>	<i>60</i>	<i>72</i>
Illness Score Months 0 to 36		.06		.04
Illness Score Months 0 to 72				.03
Health Rating at Month Tested	.22	— .05	— .01	

first three years and their mental-test scores at three years of age. Nor is there any relation at six years between mental status and the scores at that time for 'accumulated' illness. The physician's ratings of health at the time the mental tests were given show equally low correlations at 2, 3, and 5 years of age. It is possible, however, that these group trends mask significant relations between health and mental growth in certain children or in those having certain kinds of illnesses.

A detailed comparison between any one child's illnesses and his curve of mental scores affords little evidence from which one could conclude that the children's rates of mental development fluctuate with their health. In only a few instances does there appear to be anything that could be conceived of as a causal relation between disturbances in physical well-being and poor mental scores, because there are too many other uncontrolled variables for each case in which such a relation may seem to be exhibited.

If we select groups of cases representing the extremes (for our sample) in socio-economic status, we find that the eight highest cases on the socio-economic scale (7) had cumulative illness scores for the first six years averaging + .35 S.D.; that is, practically at the mean of the total group. The children in a similarly selected low socio-economic

group also have illness scores averaging $+ .35$ S.D. As there is a definite correlation between socio-economic status and mental-test score for these children after two years of age (7), it is interesting to note that this socio-economic difference appears to be in no way related to their history of illnesses.

II. SIZE AND BODY PROPORTIONS

Our data on anthropometric measures are similar to other studies in showing that mental-test scores are only very slightly related to measures of physical size or body build. The correlations given in Table I are representative of our findings. When mental scores are

TABLE I.—CORRELATIONS BETWEEN MENTAL-TEST SCORES
AND ANTHROPOMETRIC MEASURES

(The number of cases ranges from 23 to 31 for boys, and from 18 to 30 for girls.)

Measure	Sex	Age in Months						
		3	6	12	24	36	60	96
Height	Boys	.22	— .00	.09	.35	.10	.09	.27
	Girls	.04	— .07	.24	— .01	.42	.29	.17
Weight	Boys	.19	.37	— .15	— .00	— .08	— .06	.25
	Girls	— .01	.13	.08	.02	.39	.40	.04
Head Circumference	Boys	.11	— .20	— .32	.17	.21	.29	.32
	Girls	.02	.01	.05	.04	.32	.51	.43
Indexes								
$\frac{\text{Weight}}{\text{Height}^2}$	Total	.08	.35	— .16	— .04	— .13	.13	.09
Cephalic	Total	.39	.12	— .03	.04	— .22	— .14	— .11

compared with measures of size, the r 's are usually positive, but not significant for so small a number of cases; when compared with indices of build or head shape, they fluctuate around zero. The means of the r 's with height and weight are very like those given by Honzik and Jones (10), who had a much larger number of cases. When we compare individual sigma curves of height, which are the most stable

measure we have of physical growth in these children (6), with the mental-score curves, we find in some cases definite agreement between the two types of growth. Roughly smoothed height and mental curves for 47 cases were sorted into three stacks on the criterion of similarity of their general trend in relative scores; that is, cases in which the two curves tended to run parallel were called 'similar'; those which deviated in their directions were 'dissimilar'; those which were similar only over portions of the age span, or not easily classifiable under the other two heads, were called 'ambiguous.' On the basis of two independent ratings made by the author several months apart, 18 cases were estimated to be similar; 20, dissimilar; and 9, ambiguous. Although there are many minor fluctuations, and the mental-growth trends are much more variable, there does appear to be some concomitance for a fairly large proportion of the children in trends of mental and physical growth. However, if there is some fundamental growth determiner that controls both neurological and anatomical rates of development, it does not operate equally for all children. In fact, in more than half of them growth does not conform to such a rule, and chance may well account for the apparent concomitance in the others.

However, the fact that the correlations between mental scores and absolute size tend to be positive adds credence to the hypothesis that some children are maturing more rapidly than others, *both* mentally and physically. We may expect that these children, like the Chicago children studied by Abernethy (1), will as adults show no correlation between size and intelligence scores. Such an expectation is further justified by our r 's with anthropometric indices. If size is ruled out by the process of computing indices, there is found to be no relation between mental scores and a weight-height ratio or the cephalic index.

III. SKELETAL MATURITY

The correlations between mental scores and ratings of skeletal maturity¹ are again low, and not significantly different from zero, as

¹Based on Todd's standards (12). At one, two, three, and four years, ratings of the knee are available. At eight years, ratings of both hand and knee have been made from X-rays taken by the author according to Todd's specifications. It may be noted here that, since there are sex differences in the rate of skeletal development, the children are rated on standards for their own sex, and that girls are actually more mature than boys with the same rating.

is seen in the following tabulation. In some children there appear to be similar trends of development in both anatomical and mental char-

	<i>Age in Years</i>	<i>N</i>	<i>r</i>
Knee Assessments	1	52	.25
	2	43	— .07
	3	45	.06
	4	44	.09
	8	45	.09
Hand Assessments	8	45	.07

acteristics; in other cases no relation can be found; a few even have opposite trends.

The two children who are most consistently retarded in skeletal age are Cases 13M and 9M (see Figure III and Figure VI, Part II, Chapter II). The first of these children is also at most ages the most retarded mentally, but Case 9M is (between the ages of 18 and 72 months) one of the more precocious children, with outstanding superior mental scores at 2, 3, and 4 years. The two children who are most mature in skeletal growth are Cases 8F and 25M (Figure V, Part II, Chapter II of this Yearbook). Both have mental curves that fluctuate about the mean. It may be that children with immature skeletons will tend to continue development to a later age, both mentally and physically, whereas the relatively mature will reach adult status sooner. If so, Case 13M may eventually approach more nearly average adult mentality than his present IQ indicates, whereas Case 9M may turn out to be a genius (he has other characteristics of personality that make such an eventuality seem not improbable). On this same assumption, Cases 8F and 25M would be expected to reach their adult mentality early, with lower IQ's than they possess in their present accelerated phase of skeletal development. However, Abernethy's study (1) makes these surmises seem very unlikely, and what is more, during the process of growing up other factors may enter in to alter the rates of either skeletal or intellectual development.

In general, then, our data agree with those of other studies in indicating, both from the low correlations and from the large number of cases in which the curves of growth are dissimilar, that mental development is as little related to skeletal as to other aspects of physical growth.

IV. SOCIO-ECONOMIC COMPARISONS

Thus far our comparisons have been with the physical status and growth of the children. Our search for factors related to mental growth may be more fruitful if we turn to the environmental conditions under which these children are growing up. A previous study of environmental correlates (7) has shown a definite tendency for children in homes of higher socio-economic status, especially those with more highly educated parents, to make above-average scores after two years of age, whereas children whose parents have less education make lower scores. If this is attributable primarily either to hereditary or to environmental factors, such factors could also account for some of the consistent trends in mental-growth rates. But no simple explanation would be adequate for all the patterns shown, including those with alternating trends. For example, Case 20M (Figure III, Chapter II), whose parents have a high-education score, shows a consistently slow rate of growth through seven years; and Case 9M (Figure VI, Chapter II), with highly educated parents, developed very rapidly for a period of two years, but then slowed down markedly. It will be necessary to look beyond the indices of parents' ability or educational achievement to account for these children's trends in growth. For this reason inquiries have been made into the stability of certain factors in the children's homes, and into other experiences that might have influenced intellectual development.

In the summer of 1938, after the children had all passed their ninth birthdays, the parents of 38 of the families were interviewed again for information concerning their recent socio-economic status. It was not practicable at that time to interview all the 47 families who were still available for testing, although some of the information has been obtained in a more casual way for the 9 additional cases.

A comparison between the 1929 and the 1938 data for the same 38 cases will give some idea of the changes that have taken place during this decade with its major financial depression. It is seen in the following tabulation that the average income of these 38 cases has increased, but the greater standard deviation and the greater disparity between the mean and the median indicate that this rise has not been a general trend upward for all income levels. The increases have occurred more often for those whose income was already above the average in 1929. Occupational ratings have improved very slightly, on the average, and

scores on the social-rating scale are practically unchanged. The most likely explanation of this situation is that at the time the growth-study children were born most of the parents were young, and were still making low salaries, though in those occupations for which they had been prepared. Nine years later they had advanced, in spite of the

<i>Year</i>	<i>Annual Income</i>	<i>Occupational Rating</i>	<i>Social Rating Scale</i>
Mean			
1928-1929	\$3202.15	1.95	31.54
1938	\$3620.54	1.84	30.06
Median			
1928-1929	\$2899.50	1.82	31.24
1938	\$2949.50	1.69	30.95
Standard Deviation			
1928-1929	\$1813.00	.97	7.10
1938	\$2229.00	.96	7.59

depression. Of course, during 1932-1933 there were many salary cuts, business losses, and much unemployment. But in most instances these were temporary setbacks. None of these families has been on WPA, and those who receive relief now were all at least partially dependent in 1929. In a number of cases the mother found work to supplement low salaries or to tide over periods when the father was out of work. In some instances savings, or public aid, or help from other relatives were used until a regular income was reestablished.

Table II presents the correlations between five different socio-economic factors both for 1928-1929 and for 1938. Correlations for

TABLE II.—CORRELATIONS BETWEEN FIVE SOCIO-ECONOMIC FACTORS
(Figures in parentheses refer to data for 1928-1929.)

	<i>Income</i>	<i>Mothers' Education</i>	<i>Fathers' Education</i>	<i>Occupation</i>
Composite Social Rating	.74(.82)	.48(.37)	.58(.57)	.68(.69)
Family Income		.57(.24)	.64(.59)	.72(.70)
Mothers' Education			.56(.56)	.51(.57)
Fathers' Education				.65(.74)

social rating, income, and occupation in 1928-1929 and the same variables in 1938 were .74, .68, and .74, respectively. These r 's agree with the means in the preceding tabulations in showing that during this nine-year period incomes have shifted more than have occupational status or social rating. Income is now more closely related to the parents' education (r with mid-parent education is .69). Several of the other r 's have changed in magnitude. Whether any of these changes are significant is uncertain, because the populations compared are not identical (the 1938 group that gave socio-economic data include only about 73 percent of the original sample). In general, there is a positive and similar interrelationship between the five variables, at both periods.

TABLE III.—CORRELATIONS BETWEEN MENTAL-TEST SCORES AND FOUR SOCIO-ECONOMIC RATINGS OBTAINED IN 1928-1929 AND AGAIN IN 1938*

<i>Age in Months</i>	<i>Social Rating</i>		<i>Income</i>		<i>Occupation</i>		<i>Socio-Economic Scale</i>	
	1928-9	1938	1928-9	1938	1928-9	1938	1928-9	1938
1, 2, 3	.02	-.02	-.02	.20	-.14	.05	-.08	.02
4, 5, 6	-.13	-.12	-.07	.03	-.31	-.07	-.28	-.23
7, 8, 9	-.10	-.13	-.06	-.04	-.13	-.01	-.20	-.18
10, 11, 12	-.16	-.12	-.04	.04	-.07	.04	-.23	-.12
18	-.01	.03	.18	.18	.15	.21	-.01	.08
24	.30	.46	.37	.38	.37	.40	.36	.45
36	.04	.22	.15	.30	.31	.39	.13	.29
60	.20	.46	.41	.58	.50	.54	.37	.57
84	.20	.48	.44	.59	.48	.54	.34	.55
96	.27	.49	.52	.61	.50	.59	.46	.62
108	.15	.37	.46	.54	.50	.60	.37	.52
120	.21	.43	.50	.59	.53	.59	.39	.55

* The number of cases varies as follows: Social rating, 33 to 38; Income, 35 to 40; Occupation, 44 to 49; and Socio-economic Scale, 33 to 38.

In Table III are given correlations, for various ages, between mental-test scores and four of the socio-economic variables based on the 1938, as compared with the 1928-1929, data for the same families. The r 's with the more recent socio-economic measures differ somewhat from those with the earlier data in showing a more marked relation

after the first year, although critical ratios between correlations are in no case higher than 2.5. Such an increase might be explained, so far as this particular group is concerned, by the facts that in 1928 the parents were in many cases young and recently married, whereas by 1938 they had all had time to establish themselves in occupations and

TABLE IV.—CORRELATIONS BETWEEN MENTAL-TEST SCORES AND PARENTS' EDUCATION (1938)

<i>Age in Months</i>	<i>Number</i>	<i>Mothers' Edu- cation, Years</i>	<i>Fathers' Edu- cation, Years</i>	<i>Mid- parent- Education Score</i>
1, 2, 3	61	—12	—06	—14
4, 5, 6	60	—22	—22	—29
7, 8, 9	59	.00	—04	—08
10, 11, 12	58	.13	—02	.02
13, 14, 15	56	.14	—06	—01
18	51	.25	.05	.16
21	53	.36	.23	.29
24	48	.49	.40	.50
27	51	.46	.29	.41
30	47	.49	.34	.44
36	49	.46	.34	.47
42	43	.48	.29	.35
48	45	.51	.36	.50
54	44	.54	.41	.59
60	47	.51	.50	.58
72	48	.52	.49	.57
84	46	.45	.42	.50
96	47	.50	.54	.59
108	45	.47	.54	.57
120	47	.43	.58	.54

homes more truly representative of them. In general, the relation between the children's mental-test scores and socio-economic ratings increases with age.

The r 's with parents' education are given in Table IV. As would be expected, the educational status of the parents changed very little between 1928 and 1938. However, in a few instances in which the fathers were students at the time the children were born there has

been some increase in scores. For the computations between parents' education and various scores made by the children, the 1938 educational status has been used. There is a suggestion of possible differences in the children's relations to the education of their fathers and mothers. During the preschool ages the r 's tend to be higher with mother's education, but beginning at about five years the r 's with father's education are equally high, or even higher, after eight years.

The correlations between the parent's education and the children's scores in verbal ability are given in Table V. The age of first talking (two words) is only slightly related to the education of either

TABLE V.—CORRELATIONS BETWEEN PARENTS' EDUCATION
(1938) AND CHILDREN'S VERBAL ABILITY

<i>Measure of Verbal Ability</i>	<i>Age in Months</i>	<i>N</i>	<i>Fathers' Education</i>	<i>Mothers' Education</i>
Age of first talking	13*	53	.15	.21
Action-Agent	36	49	.27	.29
Action-Agent	42	43	.33	.52
Vocabulary (Stanford-Binet)†	72	48	.34	.37
Vocabulary (CAVD)†	78	40	.35	.35
Vocabulary (Stanford-Binet)	84	44	.53	.37
Vocabulary (CAVD)	90	45	.45	.39
Vocabulary (Stanford-Binet)	96	47	.51	.38
Vocabulary (Stanford-Binet)	108	45	.43	.28

*This is the mean age of first talking.

†Stanford-Binet is the vocabulary from the Stanford-Binet Scale. At 72 and 84 months this is from the 1916 revision. At the later ages it is from Form L of the 1937 revision. The CAVD vocabulary score is an adaptation of levels E through J of the Thorndike Scale. For levels F through J one-half of the items were used and these were administered orally.

parent. Later scores on the Action-Agent and the vocabulary tests show an increased relation, but after school age there are divergent trends showing a tendency toward higher r 's with the father's education, but lower r 's with the mother's.

There is a similar, though less marked, tendency toward a shifting relation between the two parents (in education) and their children's performance on the non-verbal formboards and puzzle-boards, as shown in the tabulation below. These tests, which were discussed in Chapter II, consist of a series of three formboards (the five-figure, three-figure, and Casuist) given at 5½ and 6½ years, and the Dearborn puzzle-

<i>Test</i>	<i>Age in Months</i>	<i>N</i>	<i>r with Fathers' Education</i>	<i>r with Mothers' Education</i>
Formboards ¹	66	44	.27	.50
Formboards	78	41	.29	.32
Dearborn Board ²	90	46	.35	.31
Dearborn Board	102	44	.26	.21

¹ This measure is the sum of the scores, using Arthur's system of scoring, for the five-figure, the three-figure, and the Casuist boards. (See G. Arthur. *A Point Scale of Performance Tests*. The Commonwealth Fund: New York. Vol. I. "Clinical Manual," 1930. 52 pp; Vol. II "The Process of Standardization," 1933, 106 pp.)

² This measure is the sum of the moves taken in solving three puzzles. The signs are adjusted to give positive *r*'s between good performance and high parental education.

board (three puzzles) given at 7½ and 8½ years. The formboard scores correlate higher in both instances with the mothers' education; the puzzle-boards, higher with the fathers' education. In general there appears to be a change with age in the magnitude of the *r*'s, the direction of the change being opposite for the two parents. However, in reading this table one should keep in mind that the Dearborn scores for the 102nd month are less valid than the earlier ones.

The possible significance of these differences in relation to the mother and father is open to question. In the first place, most of the differences are not large enough to be statistically significant; also, where consistency is noted from one year to the next, the peculiarities of this small constant sample may repeat for successive ages conditions that would not be found in other samples. Honzik's *r*'s (reported in a later chapter of this Yearbook) for a much larger number of cases do not show significant differences between mother-child and father-

child correlations, although the small differences recorded are in the same directions as found here.

If we contrast verbal ability with non-verbal ability as shown in solving puzzles, the former would appear to be more closely related to the parents' education.

V. FACTORS INFLUENCING THE MENTAL GROWTH OF VARIOUS SELECTED GROUPS OF CHILDREN

1. Nursery-School Attendance

Fourteen of the children attended the Institute Nursery School for periods varying from 48 to 510 days, with a mean of 262 actual days of attendance. The individual curves of these children may be found in Figures II to VII, Chapter II in this Yearbook. They are, in the order

<i>Group</i>	<i>Num- ber</i>	<i>Mid-Parent Education</i>		<i>SE Scale</i>	
		<i>Mean</i>	<i>Range</i>	<i>Mean</i>	<i>Range</i>
Nursery school	14	14.5	12.5 to 16.5	10.71	6 to 15
Control	14	14.5	11.5 to 17.5	11.50	7 to 16
Total growth study	59	13.3	4.5 to 18.0	9.83	1 to 16

of length of nursery-school attendance from greatest to least, Cases 21F, 6F, 17M, 3M, 20M, 20F, 12F, 19F, 4F, 23M, 15M, 11F, 24M, and 6M. A study of these curves reveals no tendency for children with longer nursery-school attendance to improve in their sigma scores as compared with those of shorter attendance. Comparisons between mental scores of these children and a control group are also given in Chapter II. There are no significant differences in the growth curves of the two groups.

2. Family Constellations

Among these children there are 12 who were the first-born with at least one younger sibling (mean SE rating, 10.25); there are 8 'only' children (mean SE rating, 9.25); and 21 who at present are the youngest in families of at least 2 children (mean SE rating, 10.38). As the mean socio-economic rating of the total group is 9.83 (see the accompanying tabulation), it is apparent that both the first-born

and the last-born tend to come from above-average families and the only children from below-average, though they are all similar to the total group. The curves of the mean mental-sigma scores of these three selected groups, not here reproduced, vary between $+.5$ sigma and $-.5$ sigma, with the first-borns apparently maintaining an insignificantly higher level of performance at most ages.

3. Emotionally Disturbing Factors

a. Parents Separated. There are six children whose parents are now divorced, and an additional one whose parents are separated. They have the low average socio-economic score of 8.14. One might suppose that in these families there was more than the average amount of emotional tensions and discord, and that conceivably such tensions might alter the mental development of the children. One of these children, Case 13M, is the outstandingly retarded child in the study; if he is excluded from the group, the average sigma scores run close to zero or the mean of the total group.

b. Distress at Strangeness of Testing Situation. Among those children who in infancy cried and were distressed because of the strangeness of the testing situation, there were 15 (mean SE score, 9.5) who reacted in this way to six or more tests during the first 13 months. The average of their mental-test curves is close to the group mean at all ages. No higher relationship is found here than in the r 's between total amount of crying and mental score during the first year (2). Early emotional disturbance during the testing situation seems not to have adversely affected the scores. Nor is this sensitive behavior characteristic of children who later prove to be highly intelligent.

VI. RATINGS OF ATTITUDES TOWARD TESTS

But there are still other possible explanations of the irregularities in rates of mental development. Some light may be thrown on minor fluctuations when we consider ratings of the children's attitudes toward the testing situation. Although this situation was kept as nearly as possible constant throughout, with the same examiner and the same general surroundings, the very fact that the children were developing intellectually gave different significance at different ages to the same objective situation. For the same child, the examiner might become in turn a vague moving object, a person who will pick him up

and play with him, some one to laugh with and babble to, a stranger to be feared, an adult to resist, a lady who has interesting games to play with, a friend he is eager to please. What is more, different children may go through different series of shifts in attitudes. We cannot, then, expect a child always to respond to the tests in the same manner. There are, similarly, other conditions of changing interests and varying energy-output that may affect the adequacy with which a child responds to the 'games' presented to him.

When the children were from six months to a year old, and at every test thereafter through three years, they were rated on a 7-point scale for a series of nine items, either so-called 'personality traits' or temporary conditions that might be expected to influence the results of the tests. These traits and conditions are: wakefulness; response to strange situation; activity; speed of movements; responsiveness (a) to toys, (b) to persons; amount of positive or negative behavior; irritability; and emotional tone (happy-unhappy). All these ratings, with the exception of 'irritability,' were added to form a single 'optimal score,' so arranged that a high score should indicate conditions favorable for a child to make his best possible test performance. As seen in the following tabulation, these optimal ratings, when correlated with

<i>Months</i>	<i>N</i>	<i>r</i>
12 with 13	46	.44
13 with 14	44	.68
14 with 15	44	.76
15 with 18	50	.62
12 with 24	40	.42
18 with 30	42	.15
24 with 36	39	.04

themselves for successive ages, indicate that over short intervals the children's manner of response to the testing situation remains moderately consistent. Over longer intervals, however, the ratings show no consistency in the favorableness of a child's attitude toward the tests (for example, the correlation between 18 and 30 months is .15).

After 36 months the rating schedule was changed to one better adapted to the later ages. From this Rating Scale for Reactions during Tests, devised by H. E. Jones, 13 items were combined into an 'Attitude

Score,' and five other items were used to obtain a 'Facility Score.' The general headings of the items so used are listed as follows:

Attitude Scores

Coöperativeness:

- Initial response to situation
- Secondary response to situation
- Attention to instructions
- Attitude toward task

Effort, Drive:

- Intensity of effort
- Maintenance of effort
- Association
- External distraction

Inhibition:

- Shyness in initial response
- Shyness in total situation
- Inertia in specific responses
- Response to difficulty
- Effect of failure

Facility Scores

- Comprehension of task
- Execution of task (speed)
- Manual control
- Verbal responses
- Method of performance

The correlations presented in tabular form herewith show the relative consistency of the ratings given these children as they grew older (from 27 to 84 months). Obviously, attitudes changed with growth, and similar scores are found only at similar ages.

<i>Months</i>	<i>Months</i>				
	<i>36</i>	<i>48</i>	<i>60</i>	<i>72</i>	<i>84</i>
27	.62	.26	.36	.26	.16
36		.44	.44	.45	.05
48			.64	.36	.37
60				.52	.55
72					.51

If we correlate these optimal or attitude scores for all the children with their test scores at any given age, we might expect small positive correlations, but not large ones, as there are obviously more important factors than attitudes in causing individual differences. This was found to be the case when optimal scores were correlated with mental scores for three ages: 12, 18, and 30 months. These r 's were .26, .18, and .40. The correlations tend to be higher with attitude scores and facility scores, as shown in the following tabulation. The latter ratings one

<i>Month</i>	<i>Cases</i>	<i>Facility Score r</i>	<i>Attitude Score r</i>
27	42	.88	.62
30	47	.82	.42
36	39	.72	.37
42	43	.69	.35
48	45	.80	.44
54	44	.84	.58
60	47	.82	.54
66	44	.77*	.35*
72	48	.82	.55
78	41	.39*	.16*
78	40	.49†	.42†
84	45	.72	.41

* Formboard score.

† Vocabulary score.

would expect to have been largely influenced by the tester's impression of the child's successes on the tests; hence, they should be high. There may, of course, be some 'halo effect' from test successes on the attitude scores, but attitudes do appear to be more important in these later test scores than in the infant ones. That these different scores rate similar or related kinds of behavior (or else are similar because of halo effects in the ratings) is shown in the tabulation of correlations with attitude on the following page.

But our present interest is to discover what effect changing attitudes have on the *same* child's mental-test scores. It may well be that shifts in IQ or standard scores can be attributed to differences in energy-output, coöperation, and interests as the child matures. Twenty

of the children had from 12 to 15 optimal scores and (at the time the computations were made) 10 or 11 attitude scores based on ratings made at the time of the mental tests. For each of these 20 cases a rank-difference correlation was computed between the rating-scores and the mental-sigma scores, for each of the two rating schedules. These correlations are given in Table VI. They range from $-.33$ to $+.77$ for the optimal scores and from $-.46$ to $+.76$ for the attitude scores, with frequent discrepancies between the two coefficients for the same child. The most glaring discrepancy is for Case 16M with a *rho* of $-.33$ with the optimal scores and of $+.76$ with the attitude ratings.

<i>Month</i>	<i>Attitude with Optimum</i>		<i>Attitude with Facility</i>	
	<i>N</i>	<i>r</i>	<i>N</i>	<i>r</i>
24	36	.59	..	..
27	45	.54	45	.70
30	44	.60	55	.53
33	..	..	45	.58
36	38	.55	50	.36
42			49	.43
48			53	.30
54			46	.60
60			47	.55
66			45	.64
72			47	.58
78			41	.65

There is, however, a predominance of positive correlations, and the average would indicate, again, some effect on mental scores of these personality factors.¹ But it is doubtful whether these factors are the principal causes for shifting trends in mental scores. The influences of attitude seem, rather, to be superimposed on the underlying rates of growth, and to cause some of the small irregularities from test to test. The cases in which the *rho*'s are strongly positive are often children who had marked changes in emotional attitude, or who had relatively

¹ Of course, it is also possible that (a) a poor test performance involves frustrating factors that achieve expression in emotional disturbance, or that (b) poor test performance and poor attitude are both occasioned by some underlying disturbance in development.

small changes in rates of mental growth, or both. That is, if the emotional attitudes are sufficiently strong, they may become very important factors in determining a child's score; this would be especially true if there were no other strong counteracting factors, such as chang-

TABLE VI.—RANK-ORDER CORRELATIONS BETWEEN MENTAL SCORES AND RATINGS OF REACTIONS TO THE TESTS FOR INDIVIDUAL CHILDREN

Case	Optimal Score and Mental σ Score		Attitude Score and Mental σ Score	
	Number of Ages	ρ	Number of Ages	ρ
8F	12	.66	10	.33
11M	13	.39	10	.20
11F	13	.30	11	.55
13M	13	.26	11	.02
13F	12	— .17	11	.57
15M	13	.18	11	— .04
16M	12	— .33	10	.76
17M	14	.30	10	— .07
15F	14	.70	11	.57
16F	13	.11	10	.65
17F	12	.07	10	— .24
19M	13	.12	11	.00
18F	15	.29	11	.12
21M	14	.14	11	— .38
19F	14	.77	11	.41
20F	14	— .25	11	.26
23M	15	.34	10	— .46
21F	13	.03	11	— .34
24M	15	.00	11	.64
25M	15	— .33	10	.68

ing rates of growth. What frequently happened, however, was that a rapidly developing child made good scores in spite of inhibiting fears or contrary resistances, whereas a slowly developing child could not keep his score up to its previous level, no matter how friendly or willing he might be. In such cases the correlations would, of course, be negative.

VII. RECORDS OF INDIVIDUAL CHILDREN

Generalizations based on the entire group of children, or on selected groups, have shown, at the most, only moderate relationships between mental growth and many other factors in these children's lives. However, each child's processes of development are unique and exceedingly complex. Perhaps the consideration of all available pertinent data in the development of individual cases will throw light on their variable trends in mental growth. Obviously there is not room here for detailed case histories of all the children; we must be content at present with sketches of a few. These few have been selected for their extreme deviations from the normal rate because in these extremes we may be most likely to find at least the more obvious factors that might influence the course of development. In addition, we have included the child whose scores are most nearly average throughout the nine-year span.

Jessica

This 'average' child is Jessica (2F in Figure II, Chapter II). We should expect, from the evidence of her mental-growth curve, that she has had normal opportunities to develop, and that her inheritance is normal. Of course, the term 'normal' here used is vague: we do not know the limits within which either inheritance or environment may be considered as 'normal.' Furthermore, an environment to which this child reacts normally might not be normal for another child. Jessica is the first-born of young parents, both of whom are high-school graduates. Her father is a semiskilled laborer; the mother worked before and after Jessica's birth as waitress and cashier in a restaurant and more recently in a laundry as a marker. During the depression the father was out of work much of the time. For several years the mother's work was intermittent because of her ill health. When Jessica was still very young, the mother was ill, first a miscarriage, then possible tuberculosis. A younger sister was born when Jessica was two. When Jessica was six, the parents were separated and later divorced; the reason given us for the divorce was the mother's impatience with the father's lack of ambition.

Because of the mother's illness, periods of gainful employment, and the broken home, the children have lived much of the time with the maternal grandmother, and have had several shorter periods in the country with the paternal grandparents. At the maternal grandmother's there was usually a houseful, including young aunts and uncles. Part of the time the mother lived there also, but in 1935 she moved to San Francisco and saw her daughters only on week-ends. Recently, before Jessica's tenth birthday, she married a man who runs a gas station, and she has now taken the children to live with

her. Their financial situation appears to be more comfortable than before, and the mother is no longer working. Although the socio-economic rating is below the group average, the family has never been without fairly adequate income. The grandmother is a pleasant, rather easy-going woman who is interested in the children. The girls appear to be happily adjusted to both the grandmother's and their newly established home with their mother and stepfather.

Jessica always seemed rather mature in both appearance and behavior in comparison with the other children her age. Her health has been good, with no severe illnesses. Her skeletal maturity and size are slightly above average. She is rather pretty, and usually nicely dressed. Her reactions to the testing situations have been normal and happy. From the age of four and one-half years she has been very compliant in the test situations, though sometimes she has been rather shy and self-conscious. In general, she gives the impression of having met with no traumatic experiences, and of being well adjusted to her environment.

If Jessica's mental growth had been retarded or irregular, one would have been tempted to use the broken home and parental incompatibility as explanations. However, these factors appear to have had little influence, so far, on either her emotional attitudes or her intellectual development.

Richard

Richard (Case 8M, Figure III, Chapter II), after six months of rapid development, has exhibited consistently slow mental growth. He is the youngest of three boys, the eldest of whom was only two and one-half years old at the time of Richard's birth. Both parents completed the eighth grade in school. The father was a box-maker and worker in a lumber-yard. When Dick was born, the family's annual income was \$900. The father's work has been irregular and intermittent. Soon after Dick's first birthday, the family moved into a house belonging to the lumber-yard where the father was employed. They receive this small, rather dilapidated house rent-free in return for the mother's service in taking telephone calls and performing similar 'office' duties for the lumber company. This house is very near the railroad freight yards, is overcrowded, dusty and sooty, with little place for the children to play except on the street and in the shingle yard and freight depot. The mother's brother lived with the family part of the time. One gathers from the mother's conversation that the family leads a noisy, hectic life, with many fights and loud words. When Dick was 8 months old his mother took the children and left the father for 4 months, going to stay with her parents in another state. She decided, however, to return and "stick it out and make him support them." When Dick was almost 9, the mother broke her leg in a family scuffle and had to keep it in a cast for 8 months. While she was in the

hospital, her mother came and took care of the children. During this period the father died of typhoid. The mother has been allowed to keep the house in return for continued services to the lumber company, and receives public aid for other living expenses.

Dick had only the usual illnesses as an infant. At 6½ years he had a severe case of double pneumonia, requiring blood transfusions. He was sent to Del Valle to convalesce. Since then, he has had frequent heavy colds in the winter. He has always been short for his age (around -2.0 sigma), and, after two months, has been heavy for his height. For this bicristal-height index, he is exactly the right weight. He has broad, square shoulders, a round head, and short extremities. At 8 years he is below the 7-year mean for height. His skeletal age has been about average at all ages. His health was rated as slightly below average at 21 and 36 months, but above average at 48 and 60 months.

Richard as a baby often cried for attention and gave other evidences of being his mother's favorite. His mother varied her attempts to quiet him, starting with affectionate hugging, but soon, growing exasperated, resorting to scolding and spanking. When he was small, his occasional crying during the tests seemed to be mostly protests against being put down in the crib. After the first year, he became shy and bothered by the strange situation. This reaction was acute between 2 and 4 years, definitely interfering with his performance on the tests. After 5 years, although he has appeared interested and pleased with the testing situations, he has continued to be shy and often inhibited. This environment seems to be *very* different from what he is accustomed to. He often seems tense, and under considerable emotional strain. His teacher describes him as a nervous, inhibited child. He is under par physically, and has free milk and rest periods. She reports that he is also retarded in his school work. According to his mother, he is very well able to hold his own at home; he is hot-tempered and spoiled, and the others give in to him; however, he is good about staying home, and is resourceful in earning small sums of money about the lumber-yard.

As would be expected from this description of his home, his cultural experiences have been very limited. The boys go to a movie once a week. They listen on the radio to such programs as 'Gangbusters.' The only reading matter in the house is a single book (a child story reader) that the teacher gave to the boys; their mother reports that they like to read it.

Richard's history is one of little intellectual stimulus from any point of view. He is handicapped both emotionally and culturally, and perhaps also innately. His mental-growth curve is for the most part in keeping with the history of his background (both hereditary and environmental), although this history offers no explanation of his high scores in early infancy.

Jack

Dick's case should be compared with that of Jack (Case 20M, Figure III, Chapter II). Jack's mental curve shows consistently slow development from his extremely precocious one-month score of $+3.6$ sigmas to his 4-year score of -1.5 sigma. After this age his rate of development has kept pace with the rest of the group, his score remaining consistently low.

Jack is the first-born of college-educated young parents (with a family background of teachers) recently immigrated from northern Europe. He remained an only child until 9 years of age. At the time of Jack's birth his father was a university student. In the course of several years he finished his undergraduate work, did graduate research, and obtained a good position in the line of his professional education. During the father's student years the family income was meager, coming at first from such domestic work as either or both parents could get, and later from graduate assistantships in the University. In spite of this low income, however, Jack was enrolled in the Institute Nursery School, and attended regularly between the ages of 2 and 4 years. When Jack first went to school, the family was living in a small agricultural town, and a large proportion of his schoolmates were children of Portuguese and Japanese farm laborers. When he was $7\frac{1}{2}$, the family returned to Berkeley, where Jack has made a good school adjustment. Since returning, they have bought their own home and appear to be successful and happy and very much interested in their children.

Jack has been a healthy child with few illnesses. He is about average in size, with a tendency to be slender in recent years. His skeletal development is normal. During the testing situations he has usually been very responsive to social approaches, with a very expressive face. However, he is easily upset and cries readily. Between the ages of 7 months and $2\frac{1}{2}$ years the strangeness of the testing situation was very disturbing to him; and later, around 6 and 7 years (when his tests were given during short visits in Berkeley), he was several times apprehensive lest his mother would not come for him. His parents' bilingualism was probably instrumental in retarding his speech for several years. The parents were aware of this; they attempted to speak English to him and kept him in the nursery school as long as they lived in Berkeley. However, vocabulary remains his weakest point in his mental-test performances.

In Jack's case there appear to be several contradictory forces (environmental and hereditary) that might conceivably influence or determine his rate of mental growth. To begin with, he was exceptionally mature at birth. If we assume that growth rates are inherently irregular, a regression toward the mean from such an extreme position is a very likely occurrence. Then, after the first year, his language handicap put him at a disadvantage that was operative for several years at least. Although he was easily distressed and often cried

when brought in to be tested, yet he always responded, forgot his tears, and played happily after he had had time to adjust to the new situation. He is socially responsive and eager to do well and to gain approbation for his successes. Also in contrast to the unfavorable factors are his parents' high level of abilities, their cultural interests, and their concern for his well-being, with provision of opportunities for growth and development, including his nursery-school attendance. It seems impossible to know whether any of the external influences were markedly effective in determining the course of his mental development. The only obvious retarding factor in his environment is his parents' bilingualism. But this could not have acted to depress his scores before one year at the earliest, and other favorable conditions have had surprisingly little effect.

Caroline

One of the cases showing most consistently rapid mental development is Caroline (Case 7F, Figure IV). Caroline's parents are well educated; the father is in a professional occupation that requires advanced scientific training. She has a brother about three years her senior. The family's income has been ample, steady, and increasing throughout Caroline's life. They recently built a new home in a good suburban district.

The mother shows much interest in the theory and practice of child training. However, Caroline's brother was something of a behavior problem, and had been taken to a clinic for guidance before Caroline was born. His presence at the Institute during Caroline's tests was always a trial and a great disturbance. The mother seemed often to be far more concerned with Peter than with Caroline.

Caroline had few illnesses during her early years, but developed asthma at about four and one-half years. Since this age she has been very thin, has had repeated and severe asthma, has been kept in bed for long periods or else on a restricted schedule with long hours in bed.

At about 5 months of age she cried very much during the tests, especially the physical tests and measurements, and this behavior continued until after she was $2\frac{1}{2}$ years old. She manifested strong drives to do things her own way, and to help herself without assistance (as in dressing). She had strong preferences for certain toys in the mental tests, protested at their removal, and she rejected new toys at first. Peter's presence was a disturbing factor at several tests. Her mother sent her alone to be tested at all but one test from 8 through 14 months of age. Caroline was never taken anywhere as a baby and never saw anyone but her own family. At 2 years she was "a regular chatterbox," followed her mother around the house talking and imitating her. She became very neat and orderly, always picking up things and putting them away.

As she grew older, Caroline's independence and drive to do things for herself, developed into a *very strong* drive to excel, often in competition with Peter. She uses long words and elaborate sentences, strives to do well in all problems set for her, and delights in her successes. She often has a rather strained, tense look on her face. During her enforced rest periods, it is reported, she reads a great deal. Her classmates tend to dislike her, for she is overbearing and critical. Various indications point to the possibility that her intense strivings are compensation for feelings of insecurity and jealousy of her brother and that these compensations take a turn that makes her less liked by other children.

Several factors in Caroline's life appear to be operating to stimulate her to high intellectual development. There is a probability of good inherited ability; and emotional drives have made her put forth great effort in this direction. In addition, the nature of her health has been such that she has long quiet hours for reading and acquiring 'book learning.' There is little wonder here that Caroline's mental-test scores have greatly improved. What is more, her poor early scores coincide with a period during which the testing situation was very disturbing to her.

Jane

Jane (Case 6F, Figure V) was a well-developed one-month-old who made slow progress mentally for her first eighteen months, and then, with a great spurt, moved up again from a score of -1.7 sigma to $+1.2$ sigma at three years. In her later tests she maintained this higher status, and with one exception has stayed at a consistently high level of performance.

Jane is the younger of two children. Her brother is 6 years older. Her father is an executive with a university education, the mother a high-school graduate. Both are of North European stock. They own their own home, which is rated above average. At the time of Jane's birth the family income was \$4,000. They were in no way adversely affected by the depression.

Jane has always been tall for her age. She gained weight very rapidly between 4 and 8 months, and became markedly heavy for her height. After 2 years she began to grow slender, and has continued since $2\frac{1}{2}$ years to be only slightly above average in weight for her height. In skeletal maturity she has been approximately a year advanced during the first 4 years, and is 6 months advanced at 8 years. She has had repeated illnesses, especially during her first 3 years. These were mostly colds and upper respiratory infections.

As a baby Jane was calm, placid, and relaxed. She exhibited a personality characteristic that, in various ways, has been maintained throughout her life. As early as 4 months she was noted as exceptional in her tendency

to stare at people's faces. She has always been very much attracted by people, spending much of her time looking at them intently or talking to them in a lively social manner. She showed early an awareness of strangers, but after 11 months was never bothered by them. She used them as objects for conversation and social contact or as something interesting to observe closely. Although she has always been socially interested, as she grew past babyhood this interest has been more that of an observer than an active participant. Physically she has usually been inactive, often (in the nursery school) standing and watching others, especially any visitors who appeared in the yard.

Jane attended the nursery school regularly from 2 years to 4 years, 9 months of age. She appears to be a meditative, perhaps introspective, child with a great interest in people and a good facility in language. She is rated high in all school subjects, and her teacher reports that she is talented in art.

In considering the probable influences of her environment on Jane's mental growth, our data show little relation. Her spurt in mental growth started well before entrance into the nursery school and stopped after only a year's attendance. She was never very emotionally upset during infancy when her scores were low. Her most severe illnesses (abscessed ears at 14 months and high temperature with convulsions at 20 months) occurred at the end of the period of slow development. They may have some causal relation to her very lowest scores.

Lawrence

In Lawrence (Case 9M, Figure VI), we find very rapid mental development, generally, during his first two years, followed by a gradual regression toward the mean through eight years of age. Lawrence is the third and youngest child of parents whose ancestry is 'Old American,' cultured and distinguished. The father, a commercial artist, completed a six-year university course, the mother a five-year one. The family income is moderate, and was greatly reduced during the depression. They own their own home, which is a good, modern house in a very good neighborhood.

Lawrence is growing up in an environment where education and culture are taken for granted, in an artistically beautiful, very comfortably lived-in home. The father has various artistic abilities, like playing the violin, at which he is gifted. There is, in the home, an atmosphere of encouraging the children to go ahead on their own initiative, and a genuine appreciation of the artistic results of these activities. The sister is interested in music, the older brother in writing. Lawrence is adept at such things as making his own play costumes, in making toy villages and forts, in flower arrangements, in improvised dances, and in painting.

Lawrence was a small, wiry, excitable infant, though he was not over-active physically. During his first three years he was cared for by an elderly

German woman who idolized him, read to him, and taught him German nursery rhymes. He did not seem to miss her when she left, and in spite of her attachment he is emotionally independent and self-sufficient.

He has been short for his age, and light for his length, more so at the later ages than earlier, though, after four years of age, relatively heavy for his bicristal-height index. He has always been very immature in skeletal development. At birth he was the lowest in the entire group in this respect, and at 8 years he was 2 years retarded on the Todd standards. He had relatively few illnesses during his first 2 years. A tendency to allergic reactions has been evidenced in hives and eczema. At 2½ years he had a short severe illness with swollen neck glands; at 3 years he had tonsilitis and since that time has had infected tonsils, with several recurrences of tonsilitis. His contagious diseases have been chicken pox at 15 months, and severe whooping cough after his second birthday. The physician's ratings of health, which were first made at his 2-year examination, have placed him consistently poorer than the average of the group, including such notes as "poor nutrition" and "urgent need of tonsillectomy."

Lawrence was excitable and rather easily upset by the measuring procedures. There was a period at 21 and 24 months and another around 4 years when his pronounced shyness prevented him from entering into the mental-test games until he had become more accustomed to the strange place. But once his reserve was overcome, he made very intelligent responses to the tests. He has not been interested in gaining adults' approval, and hence does not usually put forth much effort to succeed unless the task appeals to him. His concentrated effort goes to things he is interested in doing and these are not often the verbal mental tests. He usually enters eagerly into the performance tests and tests of manual skill, but has little enthusiasm for the Binet tests.

His mother says he is "temperamental." When he was 2 years old, she reported that he liked music very much and always listened when his father played evenings, remaining awake to listen. He appears to be sensitive, emotionally rather volatile, somewhat shy and introverted at times, with a good sense of humor and a lively imagination. His teachers report him as outstanding in his school work, talented, with an adult sense of humor, and very popular with other children. He is also very well liked by adults. His mother reports that, though he gets along well with children, he has little interest in their usual group play. He accepts them if they wish to join in his own projects in which he is intensely interested, and which are usually attractive to other children. These games are imaginative, 'intellectualized,' rather than active or energetic.

To sum up, Lawrence is physically small and immature; he has a history of infected tonsils and several severe illnesses, especially during his third year.

On the credit side he has excellent heredity and a high cultural background, with a home atmosphere that encourages his creative interests. One *might* postulate that his poor start in infancy was due to physical immaturity, that some of the favorable factors fostered rapid mental growth until his poor health slowed it down after two years, and that, since then, his test scores do not reflect his actual abilities because these particular tests are not the right kind to measure them. Although such things are not measured in our tests, his exceptional artistic ability has been noted repeatedly by his teachers and others.

If it were feasible to present case histories of all the children in the study, we might find groups behaving similarly to similar constellations of heredity or environment. But one gains the impression that each case is unique in respect to relevant influences, and that the complexity of factors is so great and their relative importance so variable that nothing conclusive can be said of any one of them. It does appear, however, that often a child's mental progress has no observable relation to the environmental hazards to which he is subjected, and that he continues to develop according to his own inherent characteristics more or less immune to any environmental changes if they are not violent or extreme. Probably some children are much more subject to change from external sources than are others. It is likely, also, that the development we are measuring with a limited variety of mental tests is closely related to one child's field of greatest progress (Caroline) and entirely misses that of another (Lawrence).

VIII. SUMMARY

1. In this paper the mental-growth curves of 48 children have been considered through their first 9 years, with regard to their possible relation to various known factors.

2. Although comparisons between the children's test scores and ratings of health and histories of illness give zero-order correlations, it seems probable that in some individual cases these factors have influenced the children's scores. Body build is unrelated to intelligence-test scores, though there is slight evidence that larger, more physically mature children are a little more likely to be advanced mentally. No general relation was found between skeletal maturity and mental scores.

3. In their socio-economic relations, we find the usual correspondence between mental scores after 18 months of age and parents' edu-

cation, occupation, income, and social rating, with a tendency toward increasing r 's from 18 months to 10 years. There is some indication that socio-economic factors, with the exception of education, are more closely related to children's abilities when these data are secured after the children are 9 or 10 years old or, perhaps one should say, after the parents have been married 10 years or more and are established in positions characteristic of them.

4. The children in this study who attended the nursery school gained no advantage in their test scores after a period of nursery-school attendance.

5. There does not appear to be any generally differentiating circumstances influencing the mental growth of first-born, last-born, or only children, of children with divorced parents, or of children who in infancy were very shy in the testing situation.

6. Mental-test scores have been correlated with ratings of the children's attitudes and with other behavior relevant to optimal testing conditions. These r 's are all positive, ranging from .16 to .62; but when rank difference correlations for individual children were computed between their sigma scores and their optimal and attitude scores, these correlations were found to range from $-.38$ to $+.77$. In other words, the mental performances of some children seem to be entirely unrelated to their attitudes in the testing situation, though the relation is usually positive, and for a number of the children fairly marked.

7. Descriptions of individual children include one child with an average rate of growth and others with extreme shifts in relative test scores. These case studies reveal to some extent the great variety of factors that might be operative in the developmental trends of any one child. They indicate that in some children, at any rate, mental growth is not greatly influenced by given environmental conditions, although similar conditions may be effective in altering the mental growth of other children.

In general, the influence of the environmental factors studied appears, in these children, to be moderate. Such effects as they have are not equal for all of the children, and their relative influence could not be determined with any accuracy.

IX. CONCLUSIONS

1. The fact that rates of growth in mental abilities are variable is now well established by the studies of various investigators. In addition to the studies on the group of children (4, 7, and Ch. II), described in this and the preceding chapter, are such studies as Honzik's (9), covering the ages 21 to 72 months; Freeman and Flory's (8), for ages 8 through 17 years; and Wellman's (16), from preschool to college.

2. Among the probable causes of these variations, we have been concerned in the present chapter with factors external to the child's innate intellectual potentialities — factors that might conceivably operate as hindrances or as accelerators in the process of fulfilling these potentialities. Our own data, seem, once again, to force us back to an assumption of tendencies within the developing organism as the most important factors in determining rates of growth—given environmental opportunities that may vary within a wide normal range. These children have not suffered prolonged, severe deprivations; they have all had some form of family life and parental affection; and they have all attended school since the age of six years—in most instances the Berkeley public schools. Admittedly, their opportunities and encouragements to intellectual development have been in many respects unequal. All in all, then, both our group comparisons and our case studies have shown that the children do not seem to have been affected either equally or consistently by such opportunities or deprivations as they have had.

3. To uphold a strictly environmental hypothesis, it would be necessary to assume that a sufficiently controlled environment would enable us to determine the children's rates of intellectual growth and to alter them at will. Wellman, for example, speaks in this vein when she contends that she has found environmental influences that make it possible to predict changes in IQ when the school and home environments are known. Nevertheless, no specific factors in the home and school that determine these changes have been isolated. Few of the findings of Wellman and her associates have been duplicated by other investigators, and a crucial research of this kind would be very difficult, with home and school environments as they are in this civilization.

4. Attempts to isolate the factors influencing rates of mental growth in the children of the Berkeley Growth Study point repeatedly to the great complexity of these factors, and at the same time tend to mini-

mize the influences of environmental factors on intelligence under relatively normal conditions. Although conditions in the environment contribute factors that are operative to some extent, the Berkeley Growth Study indicates that the primary factors producing irregularities in the growth of intelligence are most likely to be found in the natural processes of development in the organism.

5. There may be in most organisms periods of generally slow or generally rapid growth of any specific function. Whether that be true or not, the probability is strongly indicated that there exists, during the period of maturation, a series of shifts in the relative importance of various components of intelligence-test scores. If either or both of these indicated probabilities is true, we should expect the greatest irregularity to occur, as it does, during the early periods of rapid development.

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CHAPTER IV

THE EFFECT OF NURSERY-SCHOOL ATTENDANCE UPON MENTAL GROWTH OF CHILDREN

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The Rhode Island Investigation represents an intensive study of 54 children ranging in chronological age from 3 years, 6 months, to 6 years, 10 months, with a median chronological age of 4 years, 8 months, upon entrance to the preschool class. The length of attendance in the preschool ranged from 4 to 59 weeks; the regular daily attendance was 2½ hours, five days weekly.

Within a month after entrance each child was tested for the first time by the Stanford-Binet test (unrevised). Within a month after the termination of each child's period of preschool attendance, or at the most within a month after the following summer vacation, the same test was administered for the second time. In previous investigations the effect of vacation upon the IQ has been negligible.¹

At the first testing of the experimental group, the lowest IQ was 62, the highest 151. At the second testing the lowest was 74, the highest 140. The second test showed individual gains ranging from 0 to 25 points. In 33 cases the IQ in the second test remained within 5 points of that obtained in the first test. Of these, six of the IQ's were identical in both tests. The *mean* gain in IQ of the second test over the first was only 1.8, in spite of the large gains in some children.

The school experience of the experimental group during the preschool period was neither traditional kindergarten nor the usual nursery school, but a combination of both, called *The Children's*

¹See B. L. Wellman, "Growth in intelligence under differing school environments." *Journal of Experimental Education*, 3: 1934-1935, 59-83, in which it is reported that gains in IQ of nursery-school children are confined to the period from fall to spring, with no further change between spring and fall.

School of the Henry Barnard School, which is the training department of the Rhode Island College of Education.

The enrollment is not over 40, with two teachers and several training students to assist. There is no tuition except for children outside the immediate school district.

In this group each child is provided with the kind of activity to which he appears best suited by intelligence, maturity, interest, and general background. The activities range from the simplest motor performances to the reading of books (by the child). The work of the school encourages independent thinking, the exercise of intellectual curiosity, and enrichment of experience—factors that have been found by some investigators to contribute to a higher IQ. As soon as the child is ready, the most conspicuous objective of this early work is learning to read.

Children transferred from the Henry Barnard School to other schools are almost invariably placed in grades higher than those they leave. Evidently, the early admission of pupils, an unusually early self start in reading, and effective methods of teaching are the underlying causes of the acceleration of the pupils.

Each child is practically self-taught through self-criticism, with a minimum of direction from the teacher. The environment is sufficiently stimulating to catch his attention, to hold his interest, and to get results. Materials are presented in such an orderly sequence as to focalize the habit of reading and writing with the least possible waste of time and energy. Every success on the part of the child is evident to both himself and others, thus furnishing the setting necessary to arouse and sustain further effort.

In this study of the effect of preschool work upon the mental development of children the testing and the personal investigations were carried out by Marian Walton, of the Department of Psychology, who was in close and continuous contact with the children studied. In this way uniformity was preserved in the accumulation of data, and the usual variations of IQ due to a variety of examiners was avoided. The factor of practice in taking the test twice may be considered insignificant. In previous experiments here a median gain of 2 points after an interval of a year between tests was found, and a gain of 0.3 points after an interval of six months.

Theoretically, the effect of occupational levels of parents would seem at this time to be less significant than the effect of culture as represented by correct, refined speech and good manners, which are apt to be reflected in children. Regardless of previous occupation, the employment situation has made it necessary for individuals, in order to gain a livelihood, to engage in any occupation that chances to present itself.

TABLE I.—IQ'S OF CHILDREN IN RELATION TO EDUCATION OF PARENTS

<i>Education</i>	<i>N</i>	<i>Range</i>		<i>Median</i>	
		<i>First Test</i>	<i>Second Test</i>	<i>First Test</i>	<i>Second Test</i>
College	18	86 to 151	97 to 140	113	113.5
High school	16	84 to 121	82 to 129	101	106
Elementary school	15	68 to 112	79 to 113	101	101
Illiterate	5	62 to 106	74 to 111	88	91

Nevertheless, in the group studied, a steady increase in IQ's was found in passing from lower to higher occupational levels of parents, and in passing from meager to greater amounts of parental education, as Tables I and II show. This, of course, tallies with previous findings regarding the relation of socio-economic status to IQ.

TABLE II.—IQ'S OF CHILDREN IN RELATION TO OCCUPATION OF PARENTS

<i>Occupation</i>	<i>N</i>	<i>Range</i>		<i>Median</i>	
		<i>First Test</i>	<i>Second Test</i>	<i>First Test</i>	<i>Second Test</i>
Professional	9	96 to 151	100 to 140	123	123
Business	27	85 to 132	82 to 132	101	108
Skilled labor	13	68 to 115	74 to 115	101	103
Unskilled labor	5	62 to 123	75 to 123	88	91

When the homes of the children were classified into three groups—privileged, average, and underprivileged—it was found that the median IQ of the 28 children from the privileged homes was 109 on the first

test and 109.5 on the second; for the 20 children from average homes, 101 and 103.5; for the 6 children from underprivileged homes, 93 and 97.

Although the numbers are too small to be convincing, some of the lower IQ's found on a second testing might be related to illness, malnutrition, home conditions, or a nursery-school experience so short as not to extend beyond the necessary period of adjustment.

Children of foreign parents speaking a foreign language showed some improvement in IQ after some schooling, possibly because of a better understanding of English, a prime necessity in passing a verbal test. In one case, a child of foreign parents speaking the native language at home made a gain of 25 points in one year. His first IQ of 85 rose to 110.

All in all, however, the effect of a year's training in a superior school environment upon the intelligence quotients of these children appears to have been negligible, and this in spite of the marked educational acceleration mentioned in an earlier paragraph. Children from superior homes were found superior to those from poor homes at the time of entrance and this difference was maintained. The correlation between first test and retest after a year's interval was + .84.

CHAPTER V

MENTAL AND PHYSICAL DEVELOPMENTAL PATTERNS OF
IDENTICAL TWINS IN RELATION TO
ORGANISMIC GROWTH THEORY

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Although the mental and physical growth processes have never been shown to have more than a low positive intercorrespondence (excepting in pathological cases of amentia), the hypothesis that orderly patterns of these growth processes do exist can by no means be discarded. The mass correlation techniques often used for the appraisal of growth interrelationships, however, could not be expected to do more than suggest the presence of such patterns if these show appreciable complexity and individuality from person to person.

We may adopt for a working concept such a formulation of present-day organismic theory as Frank¹ has presented. Development is described as a "movement toward organic differentiation and coördination whereby structural and functional autonomy yields to an integration appropriate for *that organism*" (p. 13). The movement toward maturity is marked by "nodes which . . . may be interpreted as occasions when the secular trends of the different structures and functions are fairly coördinated" (p. 13). It is also marked by periods of instability, especially in early infancy and adolescence, when fluctuating rates of change and shifts of dominance in the different growth processes reveal a "lack of organic unity and coördination and dramatically portray the competition of the several processes and functions for the maintenance of their independence" (p. 13). Finally, the magnitude of change of structure or function in the growing organism at any moment is "related to the magnitude of all other structures and

¹ L. K. Frank. "The problem of child development." *Child Develop.*, 6: 1935, 7-18.

functions in that organism with greater or less immediacy, from which it follows that any perturbation within the organism will be transmitted with greater or less effect and *with varying lags* through the whole of the organism" (p. 9).

To align such a formulation against empirical growth data for individual children would not only require a most painstaking analysis of the sequential measurements available in growth studies, such as those of investigators at Harvard, Cold Spring Harbor, Iowa, Minnesota, and California, but probably, as well, an understanding surpassing any we have yet reached of the diverse array of patterns of development normally found among different children in the separate structures and functions whose interrelationships are to be appraised. There is, however, a short-cut route that can be used at least to open up the problem to preliminary exploration. This involves the study of growth data from pairs of monozygotic twins. It should be possible to ascertain, even without knowledge of the 'normal' or 'constitutional' developmental route of *either* member of a pair, whether or not perturbations in growth, as shown by a temporary or a permanent divergence in the corresponding growth curves of the twins on some particular trait, are actually part of a growth disturbance transmitted to other structures or functions with 'varying lags.' With sufficiently numerous data it might also be possible to spot chronological 'nodes' of stability and of instability and 'centers of dominance.' We shall, however, in the present study limit the investigation largely to a search for evidence regarding the *existence* of relationships between mental and physical growth. It may be remarked that, while the proposed use of a twin-comparison method is aimed at an interpretation of growth fluctuations that are non-genetically determined, it should at the same time shed light upon the nature of growth interrelationships that do have a constitutional basis, since it is the *patterning* of growth processes that is under scrutiny.

I. SUBJECTS AND MATERIALS

The material was obtained from the records of the Harvard Growth Study through the courtesy of Professor W. F. Dearborn. The data on 49 pairs of same-sex twins believed by members of the Growth Study staff to be "probably or possibly identical" were examined by the writer with respect to diagnostic criteria of the following kinds:

photographs, finger prints, recorded hair color and eye color, and recorded head width and head length. There were 20 pairs (14 male, 6 female), that, on the basis of these criteria, could be said with reasonable assurance to be monozygotic twins.

It is quite possible, however, that some of the least similar pairs of monozygotic twins were missed by the preliminary shifting of the Growth Study staff and by the further selection exercised for the present study. Moreover, it is not impossible that one or more cases of unusually similar dizygotic twins were retained. If diagnostic errors *have* entered into the selection of cases, this fact may have influenced the correlation treatments reported in this study, including the correlations between simple intratwin-pair *disparities* in physical and mental measurements. On the other hand, diagnostic errors would *weaken* the positive evidence—if any—for a correspondence between physical and mental *growth rate fluctuations* as they occur. Hence the correlations must be taken as suggestive only. Any positive evidence, however, found in the growth processes themselves may be considered significant, even though stronger evidence might have emerged if the diagnosis of zygotic origin could have been more rigorous.

The files of the Harvard Growth Study contain cards on which are recorded the anthropometric and mental measurements taken at successive annual intervals, in some cases for as long as 12 years (ages 6 to 18). For the twins serving as subjects of this study, growth data were available for periods varying from 3 to 11 years, with a median period of 7 years. The mental-test scores recorded as IQ's, it should be noted, were actually obtained from a variety of tests; in fact, the same test seldom was given on two successive years. Thus the Stanford-Binet, Dearborn, Otis, Terman, Detroit, Haggerty, Kuhlmann-Anderson, and Army Alpha are all represented. Since the point of interest in this study is that of differences in mental-test scores of twins tested at the same time, the questions of intercorrelations between tests, age norms, and so forth, are not obstacles as they would be in studies of mental-growth rates of single individuals.

II. TREATMENT OF DATA

In order to represent the data for each pair of twins graphically upon a single chart, the mid-twin values of the anthropometric measures of a given pair of twins at the highest age for which measures

were available were arbitrarily called 100 percent. The measures at lower ages were then plotted as percentages of the 100 percent values. In this way the data for height, weight, leg length, trunk length, and iliac breadth were graphed. In the case of mental-test scores, differences in IQ (Twin 1 minus Twin 2, algebraically represented) were plotted upon the same chart.

The following procedures were then undertaken:

1. Intrapair correlations were computed for male twins of a given age (that is, a 12 months' interval, 9 years, 7 months to 10 years, 6 months). This would be a check upon the representativeness of the twin material if it gave results similar to those of previous studies. (Males alone were used because the two sexes could not be readily combined in such a treatment, and the females were not sufficiently numerous to permit a separate treatment.)

2. Correlations were computed between IQ and the anthropometric traits for males of a given age (the same 12 months' interval as that used above). This would likewise provide comparative material for checking the representativeness of the data.

3. Correlations were calculated between the average intrapair IQ difference and the average intrapair difference on each of the anthropometric traits (averages taken over all ages for which data were available for a given pair of twins). Twin pairs of both sexes were combined in this treatment.

4. The growth curves were analysed more closely to detect possible correspondences between *direction of changes* in anthropometric differences and IQ differences.

For iliac, height, and trunk length, the three traits of which intrapair differences showed appreciable correlation with intrapair IQ differences, two types of analysis were made in this connection, as follows:

- (a) The graphs and original data were examined in order to locate noticeable twin deviations in growth rates of the anthropometric traits taking place within a twelve months' interval. If in a single year the distance between a pair of twins increased or decreased by the following amounts (in terms of our percentage units used for graphical purposes): iliac, 1.50; height, .75; trunk length, 1.50; then this occurrence was recorded, and the IQ difference curve was examined for corresponding changes (of 5 points or more) occurring within one year before or after the change in difference on the anthropometric trait.

- (b) The graphs and original data were examined in order to locate anthropometric growth phenomena that we have called 'loops'; that is, intratwin growth patterns in which the disparity between the numbers of a pair in growth weight on a given trait undergoes an increase followed by a decrease, or else a decrease followed by an increase. Such 'loops' were included in this

investigation if the amplitude (in our percentage units) of the maximal intra-twin difference and of the minimal intratwin difference was for the three traits in question as great or greater than the criteria employed in (a). In the case of the height measure, a criterion of .50 was used in order to secure even a few items for inspection.

For the cases in which such episodes appeared, the IQ difference curves were then examined for 'loops' of amplitude 5 points or greater. By way of example, we may refer to Figure I in which distinct 'loops' occur in leg length between ages 8 and 10, trunk length between ages 7 and 10, 9 and 11, 12 and 14, iliac between 7 and 10, 8 and 12, and IQ between 7 and 11, 8 and 13.

III. RESULTS

The following tabulations give the results of the correlation treatment of data.

Correlations between 10 Pairs of Male Monozygotic Twins of Ages 9 Years, 7 Months, to 10 Years, 6 Months, upon 6 Traits

<i>Trait</i>	<i>r</i>	<i>P.E._r</i>
IQ	.95	.02
Height	.96	.02
Leg length	.92	.03
Trunk length	.98	.01
Weight	.98	.01
Iliac	.89	.04

The first tabulation is based upon so small a number of cases that it would be open to doubt were it not for the extremely high correlations (representing the correlations on separate traits for twins presumably monozygotic).

Correlations between IQ and Anthropometric Traits for 21 Males of Ages 9 Years, 7 Months to 10 Years, 6 Months, Members of 11 Twin Pairs¹

<i>IQ with</i>	<i>r</i>
Height	.17
Leg length	.29
Trunk length	.08
Weight	— .02
Iliac	— .11

¹ Probable errors of *r* have not been computed in this set of values because the high intrapair correlations upon these traits introduce complicating factors.

The second tabulation, with its low correlations between the IQ's and the anthropometric traits of the individuals comprising the group of

twins, is unremarkable in the light of the many previous correlation studies of physical and mental traits. The third tabulation (shown as Table I), on the other hand, shows correlations (based upon intrapair *differences*) that, in three of the five anthropometric traits, are distinctly higher (from .40 to .47) than those ordinarily found between physical and mental traits.

TABLE I.—CORRELATIONS BETWEEN AVERAGE INTRAPAIR TWIN DIFFERENCES IN IQ AND IN ANTHROPOMETRIC TRAITS OF 20 MONOZYGOTIC PAIRS OF BOTH SEXES

<i>IQ Difference with Difference in</i>	<i>r</i>	<i>P.E._r</i>
Height	.47	.12
Leg length	.11	.15
Trunk length	.40	.13
Weight	.12	.15
Iliac:		
Averaged for all ages	.41	.13
One measure between ages 9 years, 0 months and 12 years, 0 months (17 pairs)	.40	.14
One measure between ages 12 years, 6 months and 15 years, 5 months (17 pairs)	— .04	.16

In the case of iliac, which, because of its clear-cut fluctuations, was subjected to somewhat more detailed analysis than the other traits, it is interesting to note that differences at younger ages (that is, *one* measure of iliac and IQ taken from the available measures of each twin pair so as to fall as near the middle of this age period 9 to 12 years as possible) show correlations about as high as do the averages taken for the entire age span. Differences at older (adolescent) ages, on the other hand, show no correlation, suggesting that the instabilities of growth with attendant precocities and lags at this period are too large to permit a correlation to emerge for measures that take only the twin differences that can be sampled at a single moment.

Using, now, the three traits that do show correspondences with respect to IQ in the magnitude of the gross intrapair differences, let us appraise the results of the more discriminating analysis of growth changes. Once again we may present the data in tabular form (Table II), this time recording the number of instances in which concordance

and discordance are found in the direction of change of anthropometric differences and IQ differences.

Considering the fallibility of mental-test data, and even of anthropometric data when collected under pressure in a massive investigation such as the Harvard Growth Study; considering also the rather liberal criteria for intratwin trait disparities accepted for inclusion in the

TABLE II.—INTRAPAIR CHANGES IN IQ DIFFERENCE WITH RESPECT
TO INTRAPAIR CHANGES IN ANTHROPOMETRIC MEASURES

1. Increase or Decrease in 12-Month Period of Intrapair Differences in Anthropometric Traits Reaches or Exceeds Criterion*

<i>Change in IQ Differences (More than 5 Points)</i>	<i>Iliac</i>	<i>Height</i>	<i>Trunk Length</i>
In same direction	11	3	13
In opposite direction	5	3	5
In both directions	2	1	15
None	8	3	12

2. Intrapair Differences in Anthropometric Measures Show 'Loops'; i. e., Gain Followed by Loss of One Twin with Respect to Co-Twin†

*'Loop' of Amplitude More than
5 Points in IQ Difference Over-
lapping Age Range of Anthro-
pometric 'Loop'†*

	<i>Iliac</i>	<i>Height</i>	<i>Trunk Length</i>
In same direction	6	2	6
In opposite direction	0	1	4
None	3	2	5

* See text II, 4 b.

† When two or more 'loops' in IQ difference overlapped the age range covered by an anthropometric 'loop,' the one tabulated was that showing the closest age correspondence, that is, the greatest age overlap.

analysis shown in Table II (the criteria being set only with a view to collecting sufficient episodes to permit some kind of statistical analysis of results); finally, considering that *concordant* variation in mental and physical growth is only *one* of the ways in which interaction or response to a general growth stimulus might take place in a particular

child, the results for changes in IQ difference tabulated against changes in iliac differences and trunk length differences are rather striking. Changes in IQ difference appear far more likely to occur in the *same direction* than in a direction *opposite* to changes in iliac differences and in trunk differences. The negative results, on the other hand, for IQ tabulated against height may possibly be due to the relative smoothness of the height curves as compared with those for iliac and trunk length. In order to obtain even a few disparity-episodes for analysis, it was necessary to set a criterion for inclusion having only half the magnitude of that set in the other two traits. This magnitude (.75 of a percentage unit) is probably not large enough to permit a dependable determination of growth perturbations if they are present—at least not on the basis of measures taken only at annual intervals.

If more cases were available, it would doubtless be profitable to analyze the data with respect to other concomitant mental- and physical-growth phenomena—as, for example, for *compensatory* perturbations. The data of Table II suggest that compensatory changes in mental- and physical-growth rates may sometimes occur, and, indeed, in a 'clinical analysis' of the charts for the 20 pairs of twins this phenomenon sometimes seemed fairly clear. A few twin-growth charts are appended to serve as illustrations of the data available for the present study and to provide suggestions for further research problems that it would be desirable to undertake.

Figure I represents a pair of male twins in which one individual takes and maintains a lead after the earliest measurements. The parallel between changes in iliac difference and changes in IQ difference is noteworthy.

The male twins of Figure II are very similar in their growth curves on the anthropometric traits, but, in so far as changes occur, they seem to be opposite in direction from changes in IQ, raising the question of a compensatory pattern.

In Figure III it may be noted that one twin accelerates and passes the other successively on IQ, leg length, iliac, height, and weight. The IQ shift, which anticipates the others, reaches stabilization sooner.

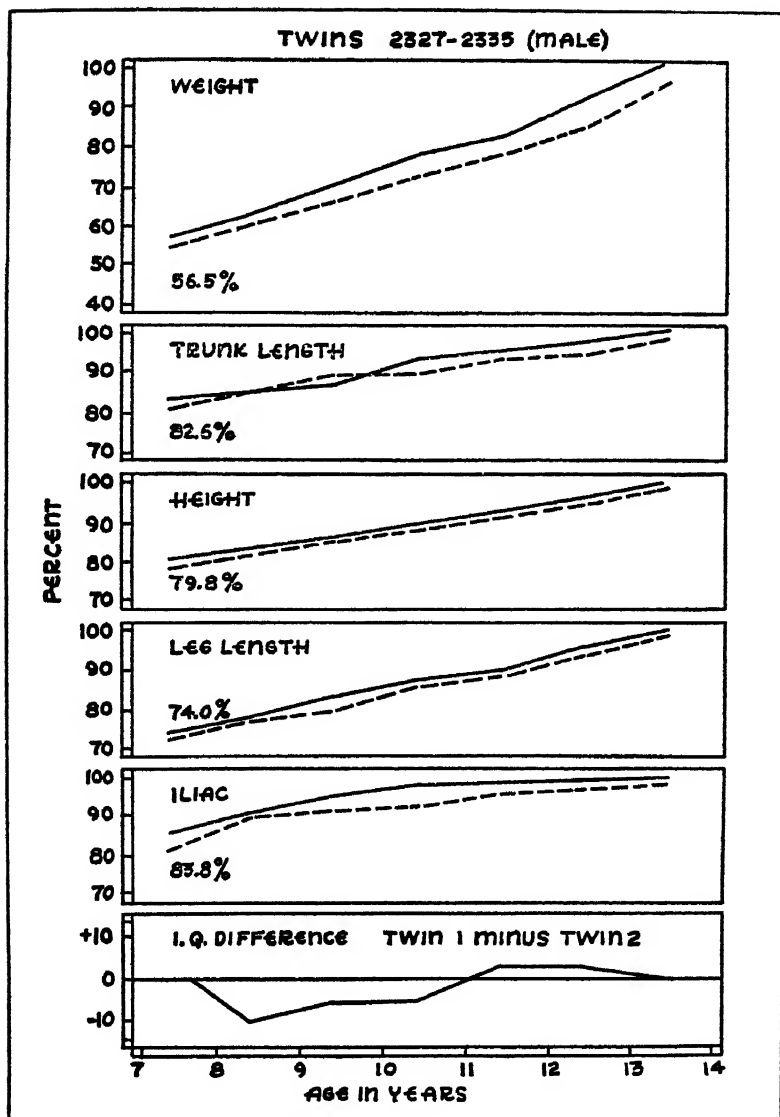


FIG. I.—GROWTH CURVES OF A PAIR OF MALE TWINS

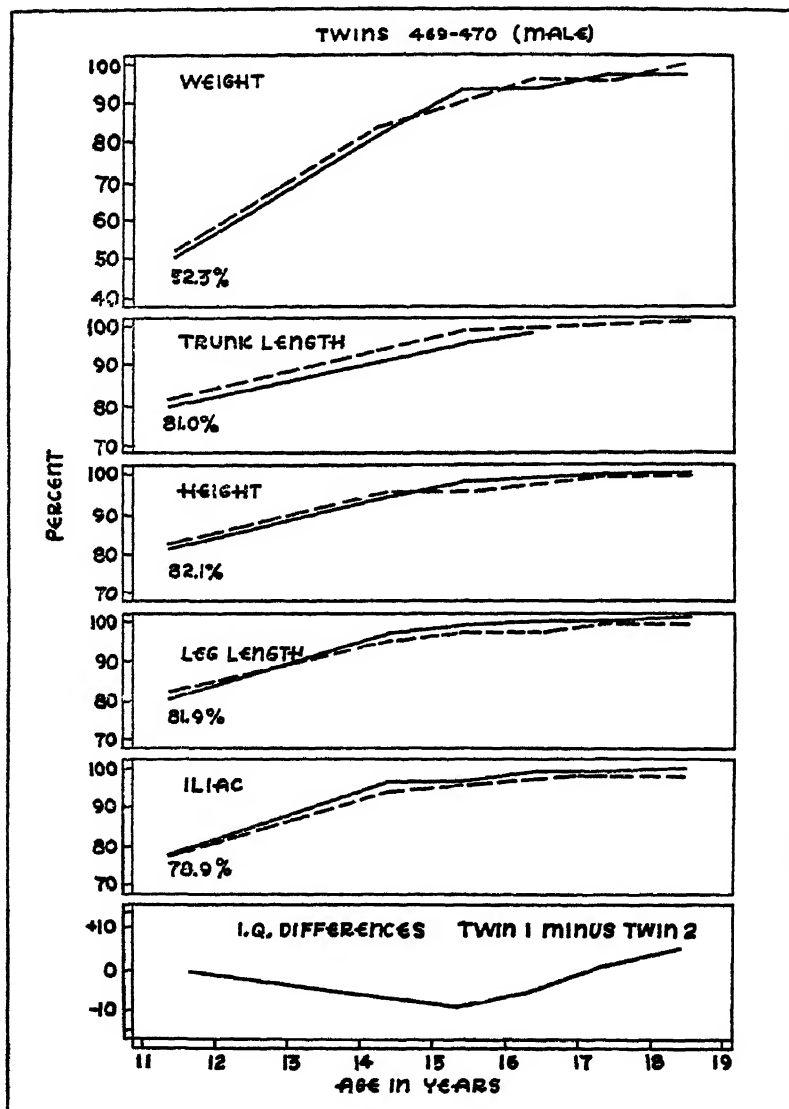


FIG. II.—GROWTH CURVES OF A SECOND PAIR OF MALE TWINS

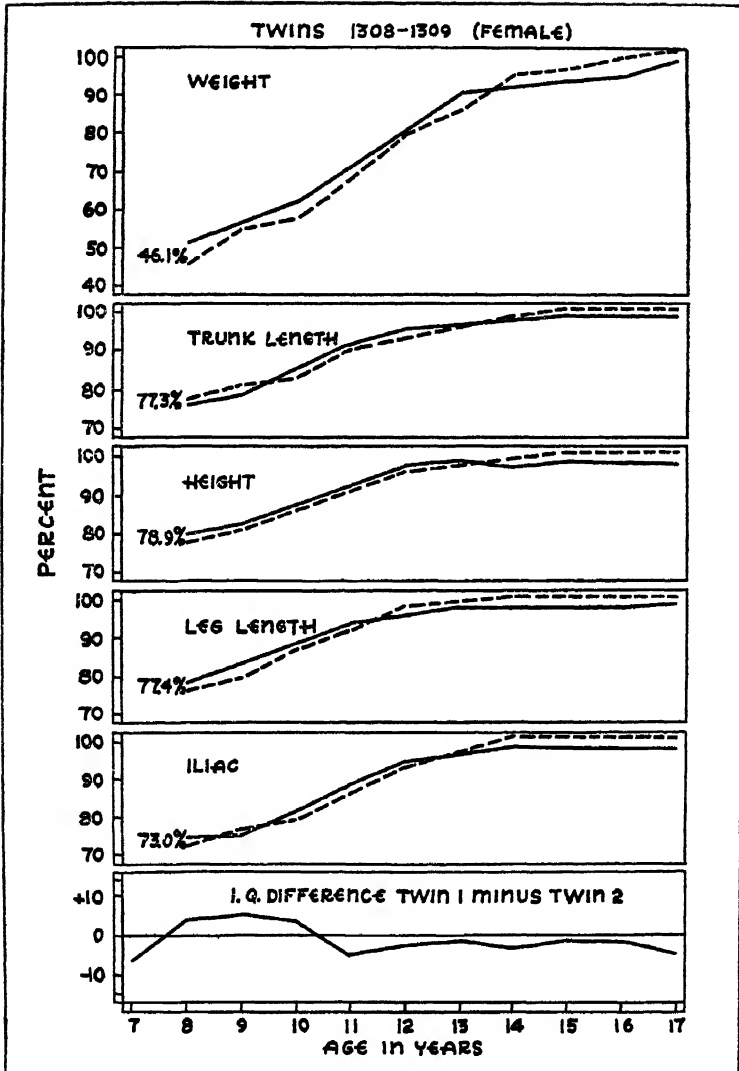


FIG. III.—GROWTH CURVES OF A THIRD PAIR OF TWINS

(The ages 7, 8, etc., on the base line are to be understood as 7 years, 11 months; 8 years, 11 months, etc.)

IV. SUMMARY

An analysis of cumulative data upon pairs of monozygotic twins whose records were available in the Harvard Growth Study has resulted in evidence for fairly striking relations between shifts in the growth rates of intelligence and certain anthropometric traits—especially iliac-width and trunk-length. It would be desirable to obtain more abundant data; while material covering as many years as that from the Harvard Study will probably not be available for some time to come, data gathered *at frequent intervals* over only two or three years of time from a larger number of twin pairs would not only provide an opportunity for checking the present results, but would also offer means for revealing additional problems of growth-patterning that have been inaccessible to other techniques.

CHAPTER VI

A SECOND STUDY OF FAMILIAL RESEMBLANCE IN INTELLIGENCE: ENVIRONMENTAL AND GENETIC IMPLICATIONS OF PARENT-CHILD AND SIBLING CORRELATIONS IN THE TOTAL SAMPLE¹

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I. INTRODUCTION

This chapter describes a continuation of a previous study (12) that appeared in the *Twenty-Seventh Yearbook* of this Society. The earlier report was based on intelligence measurements of husband, wife, and two or more children in each of 105 families. The present study is based on 997 cases in 269 family groups, including the previous 105 families, and 164 additional families of two or more members.

Studies of familial resemblance impose no direct control on either heredity or environment, and for this reason cannot yield any direct answer to the problem of the relative contribution of heredity and environment to individual differences.² In spite of this, such studies

¹ Assistance in the preparation of these materials was furnished by the personnel of Works Progress Administration Official Projects Nos. 65-3-5403 and 65-3-5406. In connection with the field work, acknowledgment is due to the Social Science Research Council of Columbia University for a grant in aid and to Professor A. T. Poffenberger as representative of the Council.

² We do not wish to overemphasize the difference between the biometric and experimental approaches in this field, particularly where human traits are concerned. The biometric studies are never entirely without the equivalent of some experimental control, and the experimental studies never completely achieve the desired control of all relevant factors. Thus, the present biometric study, having as its locale a comparatively homogeneous rural environment, achieves some control of interfamilial environmental variations. The studies by Pearson (18), Elderton (6), and Wilcocks (22) have exploited this type of experimental feature of purely biometric studies; unfortunately, these investigators overlooked the importance of the ratio of intrafamilial to interfamilial environmental variation (10), and the possibility of a significant positive correlation between the two.

are of basic importance, first in providing an essential normative background, and second in testing the validity of various hypotheses concerning environmental and hereditary influence. The correlations for familial resemblance in intelligence are of value, specifically, in relation to (a) the theory of greater nurtural influence of the mother (implying a higher mother-child than father-child correlation); (b) theories of general environmental influence (implying, for example, a higher sibling than parent-child correlation, since the conditions of development are on the average more uniform among siblings than between parent and child); (c) the theory of sex-linked inheritance (also implying a higher sibling than parent-child correlation, and higher correlations between sister-sister and mother-son than between brother-sister or father-son, respectively (2, 10); and (d) the genetic theory of dominance—also assertedly implying a higher sibling than parent-child correlation (Refs. 2 and 7). In our results we shall see to what extent the data lend support to these various hypotheses. One highly interesting finding—if we may be permitted to anticipate somewhat—is the *equality* (despite three different theories in support of a difference) between our sibling and parent-child correlations.

Two technical criticisms are more or less applicable to all studies of human familial resemblance in intelligence. First and foremost, the number of families and cases tested is usually not large enough to yield adequately dependable results. Second, and springing mainly from the first, the statistical treatment is not well adapted to existing techniques for the calculation of probable errors. The present study, though not exempt from these criticisms, possesses the advantage of a larger number of families and cases than any previous investigation involving actual intelligence tests of parents and offspring. And yet the ideal study of familial resemblance would be based on material at least a hundred times as large as the present. This would permit separate treatment for families of different size (which is desirable on several counts, including the calculation of probable errors) and separate treatment for families of different geographical and social-economic characteristics—families with mature versus young and developing children, and the like. Separate attention could also be given to results from different types of intelligence tests. The justification for the present work lies, then, not in its conformity with these ideal requirements, but mainly in its closer approximation to an ade-

quately large number of cases than has ordinarily been available. Taken in conjunction with previous studies, the data are applicable to the variety of purposes mentioned.

II. THE SAMPLE AND THE DATA

The present study is based upon intelligence measurements of 997 individuals in 269 family groups, constituting a representative sample of the rural population of a block of nine counties in west central Massachusetts and in central Vermont and New Hampshire. Two tests of intelligence were used: the Stanford-Binet (1916 revision, unabbreviated) for cases between 3½ and 14 years of age; and the Army Alpha test for cases aged 10 or over (either or both the Stanford-Binet and Army Alpha were applied in the age-range 10 to 14). The Stanford-Binet was, of course, always administered individually;¹ since all testing was done during the summer vacation, the factor of differential coöperation due to differing school attitudes has presumably been mitigated. The Army Alpha was administered to some cases as a group test in connection with free motion-picture exhibitions given in each community; in supplementary testing the Alpha was administered in the home either individually or in family groups. The procedures used in obtaining representative rural samples, and in establishing and maintaining satisfactory coöperation, have been discussed in previous reports (4, 13).

The Army Alpha test is usually considered highly verbal, and so too is the Stanford-Binet (at least at the upper age levels). For this reason, it is of interest to note that all cases in the present sample are native-born, and, with only few exceptions, of old New England stock. In all cases, it is safe to say, English is the only language spoken in the home; the factor of language handicap, then, is presumably nil. In these old-American rural districts, moreover, cultural tradition is fairly uniform and stable, the only observable heterogeneity being introduced by a small number of well-established New England families of French-Canadian descent. Variation in economic status and educational opportunities, while assuredly not absent, is nevertheless definitely more restricted than in a typical urban community. The

¹ The testing personnel for both the Stanford-Binet and Army Alpha tests consisted of the authors of this chapter and Dr. Mary Cover Jones.

comparative limitation of the cultural-environmental variable in the present sample will assume some importance in the later interpretation of results.

The 269 family groups of the present study may be classified as follows:

Group F: (a) 113 family groups in which husband, wife, and two or more children were tested; and (b) 19 family groups in which husband, wife, and one child were tested.

Group H: 17 family groups in which husband¹ and at least one child were tested.

Group W: 47 family groups in which wife¹ and at least one child were tested.

Group S: 73 sibling groups, in which two or more siblings were tested.

These groups are mutually exclusive (except for 19 adults who appear both as parents in Group F or W and as members of an adult sibling fraternity in Group S). The number of parents measured is 328 (fathers, 149, mothers, 179); the number of offspring, 688; total number of different individuals, about a thousand (997, to be exact). The range of ages included in the sample is from 3½ to 60 years.² Details concerning the number of individuals tested in each family are presented in Table I.

Table II presents an age-distribution of the principal classifications of the sample.

It may be noticed, in Table II, that for offspring in Group F, the number of Stanford-Binet tests exceeds the number of Army Alpha tests (228 versus 186, respectively); the reverse is true for the offspring in Groups H, W, and S. The reason for this is that Group F is weighted with cases from communities in which an especially persistent effort was made to obtain a complete family sampling by administering the Stanford-Binet tests to the younger children in all families in which the husband, wife, and older children had already been tested on the Army Alpha.

The larger number of wives in Group W than husbands in Group H, to be observed in Table I (47 versus 17, respectively), arises mainly from the greater

¹The terms 'husband' and 'wife' are to be understood to include separated, divorced, or widowed parents, though such individuals were rare in our sample.

²No special effort was made to test husbands beyond the age of 59; but 4 such cases (oldest, aged 63) were tested in order to complete family groups. No mothers beyond age 59 were tested.

inaccessibility of men during the daytime, when a large share of the testing had to be done. Other factors also prevented our always testing both husband and wife (and all offspring), such as illness, absence from town, absence of one or more of the family's members from the motion-picture exhibitions (at which a fair portion of the Army Alpha testing was done), overage, broken families, and so forth. On account of special administrative preparations (4, 13), unwillingness to take a test occurred relatively rarely (less than 5 percent among adults, and practically nil among children). In general, we wished to test entire families; but in some villages, owing to lack of time,

TABLE I.—NUMBER OF OFFSPRING TESTED IN EACH FAMILY
AND TOTAL NUMBER OF OFFSPRING TESTED

<i>Off- spring per Family</i>	<i>Number of Families</i>					<i>Total Off- spring Tested</i>
	<i>Group F</i>	<i>Group H</i>	<i>Group W</i>	<i>Group S</i>	<i>Total</i>	
10	1				1	10
9						
8	1				1	8
7	1		1	1	3	21
6	3		1		4	24
5	12		1	1	14	70
4	12	2	4	7	25	100
3	30	1	10	16	57	171
2	53	5	14	48	120	240
1	19	9	16		44	44
Total	132	17	47	73	269	688

testing stopped at the motion-picture exhibition or was restricted to completing the testing of families in which two or more members had already been tested at a group meeting. It should be noted particularly that families on outlying farms, who would be rather less likely to come to the motion-picture show, were not omitted in the sampling; such families were adequately included by the supplementary program of 'home tests,' and many such tests were also given to one parent when the other parent had been previously tested in a community group.

Because of our interest in sibling relationships, more effort was devoted to testing families with two or more children than to testing one-child families; childless families were obviously not suited for

TABLE II.—AGE DISTRIBUTION OF THE SAMPLE, ACCORDING TO GROUP AND TEST

Age in Years	Parents				Offspring												
	Army Alpha Test				Stanford-Binet Test					Army Alpha Test							
	Group		Hus- bands		Par- ents	Group		Group		Group F	Group		Group		Total Off- spring		
	F	W	F	H		W	S	Total	F		H	W	S	Total			
																F	W	F	H	W	S	Total
60 to 64	3	1	4														
55 to 59	7	2	4	16													
50 to 54	20	10	6	38													
45 to 49	18	16	3	45													
40 to 44	28	23	5	65													
35 to 39	20	31	3	67						1							
30 to 34	29	27	..	62						2	2	1	6	11			
25 to 29	7	20	..	28			1			8	1	5	7	21			
22 to 24	..	2	..	2			..			7	3	4	2	16			
19 to 21	..	1	..	1			..			20	1	8	10	39			
18										11	2	3	5	21			
17										14	1	4	6	25			
16										22	2	5	13	42			
15										13	6	15	8	42			
14										16	3	5	9	33			

CONRAD AND JONES

13	15	..	3	4	22	24	1	7	18	50	72				
12	13	..	5	6	24	17	1	10	10	38	62				
11	21	..	5	10	36	16	3	6	6	31	67				
10	16	1	7	7	31	15	1	3	3	22	53				
9	19	1	3	6	29						29				
8	25	..	6	3	34						34				
7	28	..	2	10	40						40				
6	29	..	3	7	39						39				
5	28	1	5	8	42						42				
4	27	1	2	4	34						34				
3*	7	..	..	4	11						11		
Total	132	132	47	328	228	4	41	69	342	186	27	76	121	410	752†

* No cases below three and one-half years.

† This number includes 64 cases (ages 10 to 13) tested on both the Stanford-Binet and the Army Alpha. Subtracting 64 from 752 leaves 688, the total number of offspring tested.

inclusion in the present study. It is safe to assume that practically all children beyond 3½ years, belonging to families in Group F, were tested. The testing of offspring in Groups H, W, and S was somewhat less complete than in Group F, as has already been indicated. There is no reason to suppose, however, that the failure to test all family groups *in toto* has had any effect on the coefficients of familial resemblance. At least in this sense, then, not only Group F, but also Groups H, W, and S, may be considered representative of the rural population forming the basis of the present study.

III. STATISTICAL TECHNIQUE

The essentials of the statistical procedure have already been described in a previous study.¹

About a third of the individuals (64 out of 190) in the age range 10 years, 0 months, through 13 years, 11 months, were tested with both the Stanford-Binet and the Army Alpha tests. Such individuals were included in correlations restricted to cases tested on the Stanford-Binet and also in correlations restricted to cases tested on the Army Alpha. For correlations where both Stanford-Binet- and Alpha-tested cases were included, the score employed (for these doubly tested individuals) was a weighted average of the Stanford-Binet and Army Alpha sigma scores, the weighting being 2 : 1 in favor of the Stanford, for cases aged 10 years, 0 months, through 12 years, 5 months, and 2 : 1 in favor of the Alpha for cases from 12 years, 6 months, through 13 years, 11 months. These weights are obviously more or less arbitrary, but they are believed to furnish a better average score than the unweighted mean. The use of average scores for 64 of the total 688 offspring admittedly involves some irregularity, since in all other instances the individual's sigma score is based on one test only. The advantage of superior validity, however, may be considered to outweigh the factor of mere uniformity, particularly since the average scores were restricted in use to those correlation tables that include both the Stanford- and the Alpha-tested cases.

The resemblance between siblings and between parents and offspring was determined by use of the Pearson product-moment correlation. An adequate number of class-intervals (between 20 and 30) was used to render Sheppard's correction superfluous. In the case of the sibling correlations, each correlation chart was rendered symmetrical by the customary 'double-entry' technique (recording the younger

¹See the *Twenty-Seventh Yearbook, Part I*, of this Society, 61-72, especially p. 67.

member of a sibling-pair first as X, and then as Y). Two siblings provided a single pair (becoming two pairs by double entry); three siblings provided three pairs (becoming six by double entry); four siblings provided six pairs (becoming twelve by double entry); and so on. The number of pairs in the symmetrical correlation chart is thus deceptively large. To counteract this, we have reported the *undoubled* number of pairs for each sibling correlation. In addition, there is reported for each sibling correlation (a) the number of families from which the (undoubled) pairs are derived, and (b) the number of individual cases on which the given pairs are based.

The problem of calculating the probable errors of familial r 's and of differences between such r 's is a troublesome one (8, 20), which we may perhaps circumvent in the present instance by the use of other criteria of reliability. Two other criteria in which some confidence may be placed are internal consistency (that is, agreement of results by different tests) and correspondence with the results from other investigators. These criteria would, of course, have to be taken into consideration even if the formal probable errors were actually calculated.

IV. PRESENTATION OF RESULTS

1. Correlations between Siblings

The correlation between siblings in our total sample (without restriction as to sex or test employed) is .49. This correlation, as indicated in Table III, is based on intelligence measurements of 644 individuals from 225 families, forming 777 sibling pairs.

Separate correlations were calculated for these groups: Group A, siblings tested on the Stanford-Binet test; Group B, siblings tested on the Army Alpha test; and Group C, siblings of whom one member of each pair was tested on the Army Alpha, and the other on the Stanford-Binet test.¹ Groups A and B are non-overlapping—except for 61

¹ Some individuals (between the ages of 10 and 14) were tested on *both* the Army Alpha and the Stanford-Binet. For such cases, in the Group C charts, the individual's Stanford-Binet score was correlated with the Alpha scores of all Alpha-tested sibs, and his Alpha score was correlated with the Stanford-Binet scores of all Stanford-tested sibs. The situation becomes more complicated, however, if *two* (or more) children in a family were *both* tested with the Stanford-Binet and the Army Alpha. In such a circumstance, the procedure just stated

cases aged 10 to 14 tested with both the Stanford-Binet and the Army Alpha; Group C, by definition, overlaps both the other groups. The correlations for the three groups of siblings are, respectively, .50, .48, and .45, none of which departs importantly from the value already given for the total population regardless of test employed, namely, .49.

Considerable interest attaches to the correlation between like-sexed versus opposite-sexed siblings, particularly in view of the greater cultural-environmental similarity for the like-sexed group. Curiously enough, the correlations for the like-sexed siblings are, in the present sample, *lower* than for the opposite-sexed group (for Stanford-tested sibs, .47 versus .55; for Alpha-tested sibs, .40 versus .55; for Alpha \times Binet sibs, .44 versus .46; for sibs regardless of test, .45 versus .54). It is possible that the family constellation involves factors of interstimulation, rivalry, or identification, that are somewhat different for same-sex than for opposite-sex siblings, and that this may be reflected in the correlational measures. We do not, however, consider the differences in *r*'s sufficiently large to be accepted with confidence, particularly since confirmation of the difference is lacking in the literature.

The general conclusion we would draw from Table III is that, in an unselected rural group of wide age range, the sibling correlation in intelligence (as measured by the Stanford-Binet or Army Alpha test) is between .45 and .54, with a fair average probably at about .49 (these figures are taken from the last line of Table III). If correction is made for attenuation, the correlation for Stanford-tested sibs (using a reliability coefficient of .90) is approximately .54, and for Alpha-tested sibs (using a reliability coefficient of .96) approximately .51. A different choice of reliability coefficients, within reason, would not alter these corrected sibling correlations significantly.

would result in *two* pairs of scores from the given single pair of (doubly tested) sibs. Since this was deemed undesirable, the rule applied in such combinations was to use one pair of scores only—typically, the Stanford-Binet score for the sib under 12½ years, and the Army Alpha score for the sib 12½ years or over. In all, there were 61 cases tested with both the Army Alpha and Stanford-Binet tests (3 additional cases so tested were without sibs); these 61 cases came from 50 separate families comprising a total of 192 offspring. There were 10 families in which two or more sibs were tested with both the Army Alpha and the Stanford-Binet; these families comprised a total of 44 offspring.

2. Parent-Offspring Correlations

It will be recalled that all parents of the present study were tested with the Army Alpha, but that offspring were tested with either the Army Alpha or the Stanford-Binet, depending on age. Separate parent-child correlations have accordingly been calculated for the two classes of offspring. The offspring in the two classes of correlations are virtually non-overlapping,¹ but 53 husbands and 61 wives have children both in the Stanford-tested and Alpha-tested offspring groups (the total number of husbands is 149, of wives, 179).

For both the Stanford- and the Alpha-tested offspring, the parent-offspring correlation is the same as the general sibling correlation; namely, .49 (see Table V). Distinguishing the parents as to sex, the husband-offspring r 's are also .49, both for the Stanford- and Alpha-tested classes; the wife-offspring r is .49 for the Stanford-tested group, and .48 for the Alpha-tested. This general uniformity of results² is disturbed only when offspring are further subdivided into sons and daughters. Among the Alpha-tested offspring, both the husband-

¹ Except for 44 cases tested on *both* the Stanford and the Army Alpha tests. We have previously stated (Table II) that the total number of doubly tested cases is 64; but of this number, 6 fall in the non-parental Group S; and 14 others not in Group S fall in the 10-year age group, which was excluded from the Alpha parent-offspring r 's. (The exclusion of the 10-year Alphas from the parent-offspring correlations, but not from the sibling correlations, was an outcome of indecision concerning the degree of validity of the Army Alpha test for the 10-year age level. The matter is of no practical moment, however, since only 19 cases are involved, and of these, 14 were tested also with the Stanford-Binet, thus entering into the parent-offspring correlations based on this test.)

² The uniformity of results cannot be explained in terms of overlapping between the various groups. Except for a relatively small number of doubly-tested offspring, the wife-offspring r for the Stanford-tested offspring is based on entirely different cases than the husband-offspring r for the Alpha-tested offspring; yet the two r 's are identical (.49). Similarly, the husband-offspring r for Stanford offspring is based on quite different cases from the wife-offspring r for Alpha offspring; and here again the r 's (.49 and .48, respectively) are virtually identical. Some of the largest differences of r 's in Table V occur between groups with a heavy parental overlapping. Homogamy between husband and wife, and the sibling relation between many of the Stanford- and Alpha-tested offspring, must also be acknowledged as factors tending toward uniformity of the parental correlations; but these factors are surely less influential than actual physical overlap, which, as we have seen, is not closely related to the uniformity observed.

TABLE V.—PARENT-OFFSPRING CORRELATIONS*

Group	Stanford-Tested Offspring			Alpha-Tested Offspring		
	Son	Daughter	Off-spring†	Son	Daughter	Off-spring†
Husband	.54	.46	.49	.42	.56	.49
Wife	.48	.50	.49	.39	.60	.48
Parent†	.51	.48	.49	.40	.57	.49

* The number of parent-offspring pairs on which the r 's in this table are based varies from 97 to 501. For more specific information on this point, as well as other related statistical data, consult Tables VI and VII.

† Regardless of sex.

TABLE VI.—STATISTICAL DATA FOR CORRELATIONS IN TABLE V*
(STANFORD-TESTED OFFSPRING)

Correlation between	Sigma Score		S.D. of Sigma Scores	Num- ber	Number Fam- ilies	r
	Mean	Median				
Husband and Son	— .16 .01	— .32 — .07	1.06 1.09	110	71	.54
Husband and Daughter	— .20 .22	— .46 .16	1.05 1.05	122	80	.46
Husband and Offspring†	— .18 .12	— .39 .05	1.05 1.07	232	101	.49
Wife and Son	— .09 — .03	— .20 — .12	.92 1.07	128	79	.48
Wife and Daughter	— .06 .22	— .12 .13	1.01 1.02	141	89	.50
Wife and Offspring†	— .08 .10	— .16 .02	.97 1.05	269	115	.49
Parent† and Son	— .12 — .01	— .25 — .10	.99 1.08	238	81	.51
Parent† and Daughter	— .12 .22	— .21 .14	1.03 1.03	263	90	.48
Parent† and Offspring†	— .12 .11	— .23 .03	1.01 1.06	501	118	.49

* Concerning the slight general excess of the standard deviations above 1.00, the difference between the means and medians, and the departure of the medians from .00 σ , see Table IV, footnote (*).

† Regardless of sex.

daughter and wife-daughter correlations (Table V) exceed the corresponding r 's for sons (.56 and .60 versus .42 and .39, respectively).

TABLE VII.—STATISTICAL DATA FOR CORRELATIONS IN TABLE V*
(ALPHA-TESTED OFFSPRING)

<i>Correlation between</i>	<i>Sigma Score</i>		<i>S.D. of Sigma Scores</i>	<i>Num- ber</i>	<i>Number Fam- ilies</i>	<i>r</i>
	<i>Mean</i>	<i>Median</i>				
Husband and Son	— .10 .04	— .40 — .10	1.02 1.09	97	68	.42
Husband and Daughter	— .01 .29	— .31 .32	1.17 1.05	99	72	.56
Husband and Offspring†	— .06 .17	— .36 .07	1.10 1.07	196	101	.49
Wife and Son	.01 .15	.07 .13	.93 1.08	128	87	.39
Wife and Daughter	.12 .32	.15 .35	.89 .95	117	82	.60
Wife and Offspring†	.06 .23	.11 .21	.91 1.02	245	124	.48
Parent† and Son	— .04 .10	— .15 .06	.97 1.08	225	96	.40
Parent† and Daughter	.06 .31	— .06 .33	1.03 1.00	216	92	.57
Parent† and Offspring†	.01 .20	— .11 .16	1.00 1.05	441	140	.49

* See Table IV, footnote (*).

† Regardless of sex.

If an attempt is made to explain the higher husband-daughter correlation on psychoanalytic grounds, it is difficult to see how the higher wife-daughter r can be similarly understood. It should be noted that the sex difference between sons and daughters in the parental r 's is not duplicated among the Stanford-tested offspring; here the husband-son and wife-son correlations are on the average somewhat *higher* than for the daughters. In a previous report on parent-child resemblance, Jones (12) studied 105 families from the present sample (without, however, separate treatment for the Stanford- and Alpha-tested offspring); he found virtual identity between husband-son, husband-

daughter, wife-son, and wife-daughter correlations. In view of this, and the negative results among the Stanford-tested sons and daughters in the present study, we are hardly entitled to attach significance to the obtained difference in parental r 's for Alpha-tested sons versus daughters.

The close uniformity of the parental r 's about .49, when offspring are included without regard to sex, lends assurance to the conclusion that this figure reliably describes the intensity of the parent-offspring relation under the conditions of the present investigation. If this parent-offspring r is corrected for attenuation (on the basis of reliability coefficients of .90 and .96 for Stanford and Alpha tests, respectively), the parental correlation for Stanford-tested offspring becomes .53, and for Alpha-tested offspring about .51. These figures are virtually identical with those previously reported in this study for the correlation between siblings.

V. INTERPRETATIONS

In view of the complexities and difficulties of the subject, it should be apparent that every study on the relation of heredity and environment to human intelligence must have limitations that only immodesty of authorship or scientific innocence could set aside as trivial. Broad conclusions or principles are our ultimate goal, but hardly an immediate practical probability; it would be difficult to imagine a field of scientific research requiring greater restraint and qualification of statement. In few fields, too, is it quite so tempting, in the evaluation of results, to overlook possibilities of interpretation that run counter to one's own particular bias or viewpoint. But fairness and, what is more, scientific progress demand that the devil (meaning those unsympathetic to one's own viewpoint) be given his due; data should conscientiously be examined for their relevance not alone to one's own, but also to rival or opposing hypotheses. When this is done, the limitations of the particular study usually become more apparent, conflicts of viewpoint become reconciled, or at least better defined, and more decisive work can be planned for the future.

In the following portions of this chapter, we shall attempt to examine the findings of the present study with considerable care and at some length for whatever relevance they may have to (a) hypotheses of environmental influence, and (b) hypotheses concerning the mechanism

of genetic¹ causation. The length of the exposition, it will be understood, springs from the complexities of the subject, rather than any exaggerated evaluation of the importance of the present contribution.

1. Hypotheses of Environmental Influence

It will clarify the ensuing discussion if we consider, first, the possible effects of environmental influence on correlational measures of familial resemblance. Environmental influences upon intelligence can conceivably (a) increase the coefficient of familial resemblance beyond the genetic or 'purely hereditary' level² (with equal or possibly different effect on the parent-offspring versus the sibling relationship); or (b) decrease the coefficients of familial resemblance (again, either equally or unequally); or (c) leave the coefficients of familial resemblance unchanged. It is not correct to suppose that all environmental influences, or the only influences requiring consideration, are those of Type *a*. Types *b* and *c* also exist. Type *b* includes, for example, all miscellaneous influences independent of family: statistically, such influences act like uncorrelated errors to lower the observed relation between family members. Type *b* also includes any and all differences or uniformities within the familial environment that, for any reason, exert a differential effect upon the family members. The possibility that environmental *differences* (either chance or systematic) may diminish familial resemblances appears obvious; the possibility that *uniformities* may lead to differential effects has not been emphasized in the nature-nurture literature, but it is clear that uniformities of familial environment may have very different effects when applied to individuals of different temperament or ability-level. Type *c* is a more or less supernumerary, statistical category, including such influences of Type *a*, the positive effects of which upon familial resemblance are counterbalanced by equal negative effects from Type *b*.

¹ Throughout this chapter, the term 'genetic' is used in its biological sense, referring to the transmission or determination of offspring characteristics through germplasm.

² For human intelligence this is itself known, of course, only on some genetic hypothesis. Thus, the genetic correlation between siblings, estimated on the assumption of dominance, will not be the same as if estimated on the basis of blending inheritance; the genetic correlation between siblings on the assumption of unequal occurrence of allelomorphic genes need not be the same as on the assumption of equal occurrence (10).

It is a curious fact that a given environmental complex may, for one type of familial relation, have an opposite effect than for another. Thus, it is common to assume that the *differences* between a pair of 'identical' twins owe their origin, apart from chance errors of measurement and response, to environmental influences. But if a correlation were found between such twins and foster children placed (without selection) in the homes of these twins, then the acquired *resemblance* (if any) between the foster children and the twins could also be ascribed to environmental influences, which are at least as different between foster-child and twins as they are between twin and twin-mate. When resemblance is high to begin with, slight differences may operate to *diminish* the resemblance ('at the top there is no place to go but down'). But when resemblance is low to begin with, slight differences may be insignificant in comparison with the essential similarities that the very slightness of the differences implies, with the result that resemblance is *increased*. Is it possible that, among siblings, the genetic resemblance is at such a level that (on the average) the net influence of environmental factors is *neither to raise nor to lower* the genetic correlation? While this question cannot now be answered, it suggests a danger involved in inferring the extent of environmental influences exclusively from the level of r 's for the various familial relations, as in methods proposed by Fisher (7). This difficulty is not encountered, of course, if attention is restricted to variations in the r 's for a single familial relation, as for example, the sibling relationship.

Finally, a general word of caution as to the applicability of results from the present study. Environmental influences can be revealed in correlations only if, and to the extent that, interfamilial environmental differences exceed intrafamilial. We have already indicated that in the stable, fairly homogeneous, rural environment of the present study, interfamilial environmental differences are of limited magnitude (though not, to be sure, entirely absent). Negative findings on environmental influence in the present study, then, would not necessarily imply the absence of significant differential effects in more heterogeneous environments, though negative findings might be considered to weaken the likelihood of such effects. Furthermore, negative findings from the present *in situ* investigation could not be depended on for prediction of what *might* or *would* happen, if certain environmental improvements could be effected (such as improved nutrition, exten-

sion of nursery-school education, and the like), though here, too, negative findings might be considered to cast doubt on the likelihood of large gains from such sources (save in special or isolated cases). On the other hand, if, in the present sample, despite its relatively limited interfamilial environmental variation, we should find evidence of definite environmental influence on intelligence-differences, then we should have so much more reason for placing confidence in the importance of existing environmental differentials and in the theoretical possibility of significant mental gain through deliberate environmental improvement.

a. Evidence from Parent-Offspring Correlations. One reasonable theory of environmental influence holds that, since the mother generally spends more time than the father with the children (particularly during the so-called 'formative years' of early childhood), the correlation between mother and offspring should exceed that between father and offspring. This higher correlation might be expected to occur, especially, (a) for the mother-daughter correlation, on the view that the mother-daughter relation is maintained throughout the period of development more fully than is the mother-son; or (b) for the mother-son correlation, on some psychoanalytic theory of special cross-sex influence. The correlations pertinent to these hypotheses, for Stanford-tested offspring, are those shown in Table V and here repeated for convenience:

	<i>r</i>		<i>r</i>
Mother \times Son	.48	Father \times Son	.54
Mother \times Daughter	.50	Father \times Daughter	.46
Average	.49	Average	.50

On the basis of the correlations above, three statements may be made.

1. The average mother-offspring *r* is virtually identical with the average father-offspring *r*; there is no support for the theory of greater general maternal influence.

2. The mother-daughter correlation is practically the same as the mother-son; there is no evidence that the generally greater association of mother with daughter has had any influence on the resemblance coefficients.

3. The mother-son correlation is not larger (it is actually .06 points lower) than the father-son correlation; no support is given to the theory of cross-sex influence.

In short, none of the proposed environmental hypotheses appears to be justified by the correlations above. Possibly, however, the parent-offspring correlations are in accord with a more involved environmental hypothesis than has yet been considered. Thus, in the case of the higher father-son than mother-son correlation, we may consider the hypothesis that the later association between father and son in these rural communities cancels or exceeds (a) the factor of early association between mother and son, and (b) the assumed cross-sex influence between mother and son. We may check the validity of this hypothesis by the standard procedure of tracing the logical consequences. If the factor of later association between parent and child has as much influence as the hypothesis requires, then presumably the mother-daughter correlation ought to exceed the father-son, since in this case both early and later association are working in the same direction. Actually, the mother-daughter r is .50, the father-son r is .54; the difference is, of course, unreliable, but in the direction opposite to that suggested by the theory under review. This situation could, of course, be explained by assuming a very strong same-sex antipolarity between mother and daughter. But if this explanation is adopted, it seems to lead to the expectation of a rather high father-daughter correlation (the normal cross-sex influence between father and daughter being augmented by the strong antipolarity of mother and daughter). Unfortunately for this explanation, the father-daughter correlation is the lowest (even if unreliably the lowest) of all the r 's under consideration. But we notice in Table III (if our attention may be permitted to wander from the parental to the sibling correlations) that the brother-sister correlations are rather consistently higher than the correlations between like-sex sibs. This suggests that the supposed strong antipolarity between mother and daughter finds its expression not in susceptibility to influence from the father, but to influence from the brothers in the family. The high brother-sister correlations seem to provide the key to the situation! Yet if we continue to examine Table III, some doubt may arise. The mother-daughter antipolarity, we have assumed, is especially strong; by definition, then, the masculine (father-son) opposition is less strong; from this it seems fair to infer that the mas-

culine, brother-brother antipolarity is also less strong (or, at least, not stronger) than the sister-sister. If this be the case, why do the brothers have the lowest sibling correlation, .39?¹ The answer may be that the brothers are more independent than the sisters in their comings and goings, in their interests, their activities, and so forth. In that event, should not the parent-son correlation (in the absence of differential biologic heredity) be lower than the parent-daughter correlation? Actually, however, the parent-son correlation is on the average not lower, but a trifle higher, than the parent-daughter. *We do not seem to be able to find consistent accord between the empirical facts and any of the environmental hypotheses being considered.*² Either of two conclusions is possible: first, lack of empirical support for the environmental hypotheses implies that the supposed environmental factors are without significant differential effect in the present sample; or second, the supposed environmental factors are operative and effective, but counterbalanced by other (as yet unidentified) factors. Of these alternative conclusions, the second suffers from vagueness tantamount to unverifiability. Whether such vagueness is more closely related to truth or untruth is more than one dares to say!

The preceding discussion has been based wholly on the parental correlations for the Stanford-tested offspring. The correlations for the Alpha-tested offspring are presented on the following page. The correlations may similarly be examined with reference to three theories.

1. The theory of greater general maternal influence on mental development is not supported by the virtual identity between the average mother-offspring and average father-offspring r 's, .50 versus .49.

¹ See footnote to Table III.

² It is possible to complain that the discussion has strayed too far from its starting point. But such a charge may be returned in reverse. The sequence of discussion, it will be observed, has been: hypothesis-objection; further hypothesis-further objection; further hypothesis. No discussion need stray very far, if it be allowed to terminate at the first objection, or at the second hypothesis. The complaint of diversion is most likely to be introduced by the party failing to have the last word! We can see no wrong in applying the test of logical consequences, so long as the hypotheses and objections stick to the facts, and do not enter the realm of entirely unverifiable speculation. Rationalization of an *idée fixe* typically meets the test of logical consequences very poorly; no scientific hypothesis can be regarded as specially valuable, unless it meets this test with appreciable success.

2. The theory of later associational influence is favored by the high mother-daughter correlation of .60, but the low correlation for father-son (.42), especially in connection with the relatively high correlation for father-daughter (.56), contradicts the theory.¹

3. The theory of same-sex antipolarity may be regarded as supported by the relatively low father-son correlation, but the high mother-daughter correlation (.60) constitutes equally strong evidence against it.

	<i>r</i>		<i>r</i>
Mother × Son	.39	Father × Son	.42
Mother × Daughter	.60	Father × Daughter	.56
Average	.50	Average	.49

On their face, the detailed patterns of correlations for the Alpha- and Stanford-tested offspring groups are rather different. In one, the father-son correlation is the highest (.54); in the other, next to the lowest (.42); in one, the father-daughter correlation is the lowest (.46); in the other, next to the highest (.56). These irregularities are doubtless most safely referred mainly, if not wholly, to random fluctuation of sampling. On one major point, however, the parental correlations for both groups of offspring are in complete accord; namely, in denying to any of the specific environmental hypotheses the sanction of direct, obvious, and consistent support. The possible conclusions from the parental correlations for both the Stanford-tested and the Alpha-tested offspring are exactly the same.

b. Evidence from Sibling Correlations. (1) Sex Differences. The sex of an individual is commonly thought to have some influence on the environment to which he or she is exposed. For instance, girls typically play principally with girls, have different amusements and values from boys, tend generally to adopt a more docile or amenable attitude toward school work. It is, therefore, reasonable to expect that (in the absence of counterbalancing factors) the resemblance between like-sexed offspring in the family should, on the average, be higher than that between unlike-sexed offspring. We do not, however, find this to be

¹In these rural communities, where relatively few men have work keeping them away from home, we may quite safely suppose that the association between father and son has considerably exceeded that between father and daughter (for offspring of the age of this Alpha-tested group).

the case in the present sample; indeed, the obtained difference, whether reliable or not (see Table III) is in favor of the opposite-sex coefficients.

If cross-sex influences (such as might be favored by psychoanalytic theory) are invoked to explain higher opposite-sex sibling correlations, it is probable that such influences should be similarly inferred with regard to parent-offspring resemblance; this (in addition to other environmental hypotheses) would imply an especially high mother-son correlation, but such, as already stated, is not found in the present data; in fact, the mother-son correlation for the Alpha-tested offspring is the lowest parental correlation of all those in Table V. We have already indicated the probable unreliability of the difference between the like-sex and opposite-sex coefficients.

(2) General Level of the Sibling Correlation. If environment is influential, it is reasonable to suppose that an expansion of the cultural variation enjoyed by a group should be accompanied by an increase in differential environmental effect. Under such a circumstance, one might expect the correlation between siblings to rise. As a matter of fact, however, the correlation between siblings, as reported by many investigators (15, 19, 22), appears to be independent of the cultural variation to which the siblings have been exposed. The correlation in our total group, .49, is very similar to that reported by others. The fair uniformity of sibling correlations, regardless of degree of inter-familial environmental variation, is the more impressive when one remembers that increased cultural variation is commonly associated with increased heterogeneity of parental endowment (and possibly also increased homogamy), which should be expected to raise the sibling correlation still more. On the other hand, increased inter-familial differences may be accompanied by increased intrafamilial differences; these might operate to emphasize whatever discrepancies of sibling intelligence may have existed in the first place. Further insight in this field doubtless awaits a fuller body of data on parental intelligence, an improved understanding and measurement of environmental variation, and a fuller knowledge of the relevant genetic mechanism.

c. Evidence from Sibling versus Parental Correlations. It seems a fair assumption that the conditions of development between siblings

of a family are on the average more uniform than those between parents and offspring (2, 10). On this basis, the correlation between siblings should exceed that between parents and offspring, and particularly so, since on no genetic hypothesis (involving a reasonable value of the marital coefficient) does the sibling correlation in intelligence fail to equal or exceed the parental. The following relevant raw correlations for Stanford-tested and Alpha-tested offspring are taken from Tables III and V:

	<i>Sibling</i> <i>r</i>		<i>Parent-Offspring</i> <i>r</i>
Stanford sibs	.50	Parent \times Stanford-tested offspring	.49
Army Alpha sibs	.48	Parent \times Alpha-tested offspring	.49
Average	.49	Average	.49

Obviously, the raw correlations do not indicate a higher sibling than parent-offspring correlation; nor would correction for attenuation alter the situation. The present data evidently fail to support the environmental hypothesis under consideration.

Willoughby (23, p. 261) found a somewhat smaller parental than sibling correlation (.35 versus .42, corrected for attenuation). On the other hand, the (unweighted) average of Outhit's sibling correlations is, as in our case, identical with that between parents and offspring (16).¹ While the sum total of available data from Willoughby, Outhit, and the present study are not, perhaps, sufficient to support a positive statement that the sibling correlation equals the parental, the evidence to date is nevertheless in that direction.

d. Conclusions on Environment. Neither the evidence from parent-offspring correlations, from sibling correlations, nor from sibling in comparison with parental coefficients provides support for the various hypotheses of environmental influence that have been considered.

¹The relatively low correlations reported by Willoughby are probably related to the fact that Willoughby's coefficients are an average of familial resemblance in *individual subtests*, rather than in a total intelligence test (3). The relatively high *r*'s reported by Outhit (average about .58) are probably related to the marked platykurtosis of the parental distribution of intelligence in her sample.

Such a uniformly negative finding hardly favors the view that definite environmental effects on intelligence have been concealed merely by fluctuations of sampling.

1. One possible conclusion is that differential environmental influences on intelligence-test scores are too small to be reflected in the correlation coefficients.² For the present rural sample, this may be a function (to some extent) of the limited difference between intra-familial and interfamilial variation in cultural advantages.

2. A second possible conclusion is that environmental factors are influential (to an unknown degree) but, on the average, counterbalancing.

Whether the first or second of the suggested conclusions is the more valid cannot be decided without consideration of evidence beyond the scope of the present investigation. The second conclusion is, no doubt, more palatable than the first, since it suggests the possibility (theoretical, even if not immediately practical on a wide scale) of partial control of mental development through amelioration of negative, and emphasis of positive, influences. It should be recognized, however, that the first conclusion does not deny the possibility of environmental control; what it asserts is that *existing differentials* of environment, in the sample studied, are without apparent influence. It is not asserted that wider differentials would be ineffective, though doubt may be raised as to whether changes of the necessary magnitude are practically attainable.

2. Hypotheses of Genetic Causation

From the point of view of the statistical-genetic theory of human inheritance, the simplest situation would be presented by a population (a) at equilibrium in the trait under consideration, (b) mating unselectively, and (c) in a uniform 'normal' environment (or an environ-

²This negative conclusion covering environmental influences appears to conflict with the writers' inference, from a previous study (14), that part of the rural-urban difference in Stanford-Binet IQ may be attributed to rural environmental handicaps. The previous study, however, was interregional and concerned with measures of central tendency; the present study is distinctly intraregional and concerned with familial resemblance as measured by correlation. A small adverse influence by rural environment, affecting sigma scores of *all* individuals in a community more or less *uniformly*, would not exert a discernible influence on the correlation coefficients.

ment without significantly influential differences). The first of these conditions, equilibrium, has numerous implications, of which specific mention may be made of (d) non-differential fecundity and survival, for different segments or strata of the population (except, of course, as a function of chronological age). Finally, and most important, analysis of human inheritance requires (e) dependable pedigrees comprising as many characteristics, ancestors, and collaterals as possible.

The 'pedigree records' (if they may be so named) of the present study are indeed limited, consisting simply of intelligence measurements of parents and children at a single, arbitrary date. The other desiderata mentioned above, however, are more satisfactorily met, particularly conditions *a*, *c*, and *d*.¹ Condition *b* (random mating) is not fulfilled, but (what may serve equally well) the degree of homogeneity is fairly definitely known (the correlation between husbands' and wives' sigma intelligence scores being .52).² On the whole, then, the present sample appears at least moderately well suited for the investigation of certain statistical-genetic hypotheses. Even the most enthusiastic environmentalist will readily admit that heredity plays some part in the determination of individual differences in intelligence, and that an examination into the genetic mechanism should be of interest and possible value.¹

a. Sex Linkage. Terman's (21) sampling of children with high IQ's yielded, as is well known, a disproportionately high frequency of boys over girls. This suggests some relation between intelligence and sex, at least at the upper intelligence levels. But intelligence is assuredly not inherited as a purely sex-linked characteristic for these reasons: (a) purely sex-linked inheritance would imply a definitely higher mean for males than females (which is not found), and (b) purely sex-linked inheritance would, as Hogben (9) has shown, imply certain correlational relations, which are not observed; for example, a father-

¹ Concerning condition *c*, see *V, Interpretations, 1. Hypotheses of Environmental Influence*; concerning condition *d*, see Ref. 5.

² Related statistical constants for husbands and wives are, respectively: mean = $-.10$ and $+.03$; median = $-.27$ and $-.08$; and standard deviation = 1.04 and $.92$. These are all in terms of sigma score. Number of husband-wife pairs, 132.

³ In what follows we are well aware that, while failure of a genetic theory to fit the empirical facts justifies the rejection (or partial rejection) of the theory, the agreement of theory with fact is *evidence, though not proof*, of the validity of the theory. Some other theory might fit the same facts equally well.

daughter correlation equal to the mother-son, but much higher than the father-son; a much higher sister-sister than brother-sister correlation; and a higher general sibling correlation (that is, without regard to sex of sibling pairs) than general parent-offspring correlation.¹ Cursory inspection of Tables III and V is sufficient to indicate the nonfulfillment of these conditions. If sex linkage occurs in the inheritance of human intelligence, it apparently involves too small a number of genes observably to disturb the autosomal statistical relationships, even if it should increase the proportion of very bright males.²

b. *Blending*. In inheritance of the type known as 'blending,' the heterozygote, or hybrid, is, on the average, intermediate between the two parents. The theory of blending accords well with certain observed facts; namely, the fact that offspring-intelligence correlates equally with intelligence of the superior versus the inferior of two parents (12, 16), and also equally (when allowance is made for the difference in parental variability) with the more deviate versus the less deviate of two parents—deviations being measured from the central tendency of an unselected adult group (12). There are, however, two salient facts of familial resemblance with which the blending theory is at variance. We consider first the relation of the blending theory to the thoroughly authenticated phenomenon of regression.

By the blending theory, the average height of the offspring of husbands and wives who measure 6' 6" and 6' 4", respectively, should be identical with the height of the midparent, or 6' 5". Actually, of course, the average height of offspring from such parents would, through regression,³ be considerably less than 6' 5". And the same regression is

¹ These relations are derived by Hogben on the assumption that mating is unassortative, differential environmental effects are *nil* or counterbalancing, allelomorphous genes (such as *A* and *a*) occur with equal frequency, the male is the heterogamete, and so forth. The assumption of random mating, especially, is an unfortunate restriction of the general applicability of Hogben's results; but it seems quite unlikely that homogamy of the degree in our sample ($r = .52$) would disturb the direction of any of the relations mentioned.

² The higher proportion of bright boys than girls may possibly be due, of course, either wholly or partly to environmental influences operating with a net differential favorable to superior boys.

³ Regression theoretically does not occur in purebred homozygous lines; but the wide individual differences among human beings, coupled with the absence of inbreeding, renders considerations appropriate to homozygous lines irrelevant for the present discussion.

observed in the case of intelligence; in the present study, since we are using sigma scores, with standard deviations equal to 1.00, the regression is given directly by the coefficient of correlation, as consideration of the formula for the regression coefficient of intelligence of offspring on intelligence of parents will show. Since the blending theory fails either to predict or account for regression, it is evidently entirely inadequate, in this important respect at least, as a theory for the inheritance of human intelligence.

Furthermore, the blending theory does not lead to the parental or sibling correlations actually observed unless one assumes (what is generally contrary to the fact) that mating is completely nonselective. In the present sample, the marital coefficient for intelligence is not .00, but .52.

It would be profitable, if space permitted, to pursue this matter in detail, making use of certain formulas provided by Fisher (7).

Suffice to say here that the parent-offspring correlation, p , as computed by his formula, would be .72, whereas our actual parent-offspring r is not .72, but .49. *The blending theory evidently leads to a value of p , the parental correlation, far in excess of the value actually observed.*

The blending theory fails equally to predict the sibling correlation. For the sibling correlation (symbolized by f), the formula as given by Fisher (7) would yield $f = .71$, but our actual sibling r is not .71; it is .49. *Again, the blending theory leads to a value far in excess of the value actually observed.* According to Fisher's formulas, then, the blending theory fails, by a very wide margin, to predict either the parental or the sibling r 's. Nor can this failure be assigned to Fisher's failure to consider other than *random* environmental influences. The effect of systematic environmental differences, correlated with the individual's native level of intelligence, should ordinarily be expected to raise parental and sibling r 's above the genetic level (or, at any rate, not to lower them below the genetic level). If this be so, then the taking into account of systematic environmental differences in the formulas could not *lower* the expected r 's according to the blending theory, but might *raise* them—to a level even farther above the actual, empirical value of .49.¹

¹The blending theory cannot be reconciled with the empirical facts except by the help of an improbable environmental hypothesis. If individuals were *extremely sensitive* to minor environmental differences, then familial resem-

Both, then, on the ground of failure to predict the empirical sibling or parental r 's, and the failure to predict or explain the phenomenon of regression, an unqualified blending theory of human inheritance of intelligence is seriously deficient. This is important, since there seems to be an easy assumption among many educators and psychologists, and even apparently among some mathematical geneticists, that 'blending' is the typical and adequate explanation for human inheritance of quantitative traits. 'Blending' may, in truth, play some part in such inheritance; but the blending theory by itself is clearly inadequate.

c. *Hurst's Theory of Inheritance of Human Intelligence.* This theory, coming from a well-known and reputable English biologist (11), deserves special consideration. The theory involves a major pair of genes, Nn , and five minor pairs of genes, Aa , Bb , Cc , Dd , and Ee . Any individual with constitution NN or Nn (regardless of what minor genes he possesses) is 'normal'—that is, at Grade 5 in Hurst's ten-point scale of intelligence; in other words, N is a dominant gene for 'normal' intelligence. Individuals can differ from the normal, Grade 5, only if they carry the double recessive nn . For those carrying nn , the minor genes, A , B , C , D , and E , each act as unit *increasers*; a , b , c , d , and e act as unit *decreasers* (in the sense that they replace the positive genes A , B , C , D , and E , respectively, without themselves making any contribution to the individual's intelligence). Thus, an individual with the genic constitution (nn) ($Aa Bb Cc Dd Ee$), having 5 increasers in the presence of nn , would belong to Grade 5 in intelligence. An individual with the genic constitution (nn) ($AA BB CC DD EE$) would be at the top of the scale, at 10; but an individual with the gene-constitution (Nn) ($AA BB CC DD EE$) would be at 5: in the presence of N (whether NN or Nn), the minor genes are entirely without any (phenotypic) influence. Hurst claims that his hypothesis adequately explains certain familial data on Leicestershire families (parents and children), as well as Woods' data on royal families.

blances might be *reduced* by such differences to a point below the genetic expectation—say from a parental correlation of .72 (our figure according to the blending theory) to .49 (the empirical value). Within our knowledge, no convincing evidence for such *extreme* sensitivity to existing differentials has yet been adduced from scientific investigations, from teaching experience, or from general observation.

The theory of Hurst is probably an improvement on the simple blending theory, but it is still clearly inadequate. According to Hurst's theory, when two *nn* individuals mate (and *all* individuals not at Grade 5 are *nn*), the offspring should, on the average, be equal to the midparent. We know, however, that unless the midparent be at the mean, the average offspring is typically not at the midparental, but at a regressed, value.

Hurst's claim that his theory fits the Leicestershire and royal family data, we must regard as misleading. Hurst seems to have fallen into the error of circular reasoning. The genic constitution of parents is inferred (on the basis of the genetic theory described above) from ratings of the parents' intelligence *and from ratings of the intelligence of the offspring*; then it is observed that the intelligence of the offspring conforms to what is demanded by the theory. We contend that, if Hurst wished to test his theory, he should have observed whether the offspring of the offspring, the *F*₂ generation, turned out according to expectation. As it is, the theory *lacks an independent test*. This lack could more readily be overlooked if Hurst had submitted his theory to a thorough mathematical-genetic examination. Does the supposed genic constitution of the parents in Hurst's groups have a reasonable proportion of dominant *N*-genes in relation to recessive *n*? Does the theory lead to an equal correlation between offspring and more deviate parent, as between offspring and less deviate parent? Does the theory lead to a normal distribution of intelligence in a population at equilibrium? Since Hurst does not answer these questions, since he had not put his theory to an independent test, and since the theory is not in accord with the known facts of regression, it is impossible to accept Hurst's statement that the theory fits the facts. The theory is an interesting advance. Based primarily on previous research on certain quantitative characters in wheat, it is in accord with the spirit of modern genetics; but as applied to human intelligence, it is definitely and specifically inadequate.

d. The Problem of Dominance. One of the defects of the 'blending' theory of inheritance, as has been noted, is its failure to predict or explain the phenomenon of regression. Regression can be readily explained, however, by the supposition of recessive allelomorphs of dominant genes. If extreme individuals (whether bright or dull) carry a large proportion of recessive (or partially recessive) genes for a multiple-factor trait, the offspring of such individuals may be expected, on the average, to suffer regression toward the mean and the greatest regression to be shown by offspring from the most recessive-laden (most

extreme) parents.¹ In terms of current genetic theory, the phenomenon of regression seems to require the assumption that proximity to the mean is an essentially dominant characteristic.

If dominance (either complete or partial) is accepted, what are the logical consequences? Fisher (7) writes of "the similarity in siblings of the effects of dominance, which *causes the fraternal correlation to exceed the parental*" (italics ours). The evidence with respect to intelligence, however, indicates *equality* of the sibling and parental r 's (Tables III and V). Apparently, then, we have here, with respect to human intelligence, evidence against the theory of dominance, and particularly so because a consideration of possible environmental effects would also favor a higher sibling than parental r .

In this instance, however, the trouble lies not in the theory of dominance, but in Fisher's statement, which requires modification for the influence of homogamy. The correlation between husbands and wives in the present sample (Fisher's μ) is .52. Applying this figure in Fisher's own formulas for p , and f , and assuming, for simplicity, that $c_1 = 1.00$ (meaning absence of environmental effects), and $c_2 = 2/3$ (meaning perfect dominance), we find that $f = .532$ and $p = .507$. The fraternal correlation here is, to be sure, greater than the parental, but *hardly enough greater for the difference to be observed regularly in empirical data subject to sampling error*. If, instead of assuming $c_1 = 1.00$, we take $c_1 = .95$ (with c_2 still equal to $2/3$), we find $f = .500$ and $p = .481$, so that the difference between f and p is again too small to be observed regularly in empirical data. The equality of empirical figures for parental and fraternal correlations in intelligence cannot, therefore, when homogamy is as high as .52, be taken as weighty evidence against the theory of dominance.²

¹ Variation of degree of regression in different families at a given distance from the mean is attributable to differences in degree to homozygosity of parents and to chance union of gametes.

² As a matter of fact, with very high values of μ (of the homogamy coefficient), the fraternal correlation to be expected by Fisher's formula is actually *less* than the parental—as the reader can easily discover for himself by substituting, in Fisher's formulas for p and f , values of μ above .75 (taking $c_1 = 1.00$ and $c_2 = \frac{2}{3}$); if c_1 is taken less than 1.00 and c_2 taken greater than $\frac{2}{3}$, a homogamy coefficient of less than .75 is sufficient to raise the parental correlation above the fraternal. Values of c_1 could be taken sufficiently low to preserve the excess of the fraternal over the parental correlation, regardless of the value of μ . But values of c_1 below $\frac{2}{3}$ would hardly have meaning within the Mendelian system, since perfect dominance is already reached at $c_2 = \frac{2}{3}$. A figure for c_1 below $\frac{2}{3}$, then, would represent a state of dominance that is more complete than complete—a possibility, indeed, not overlooked by Fisher, but still without known biological reality (7).

In a different category, however, is the evidence now to be presented. We have already set forth the view, based on the fact of regression, that proximity to the mean is an essentially dominant characteristic. If this is so, then, particularly with homogamous mating, we may expect that offspring from the relatively dominant parents at or near the mean should display comparatively little variation. The greatest variation of offspring should be expected not perhaps at either extreme of intelligence—the extremes of intelligence may be approaching recessive homozygosity, which, in connection with homogamy,

TABLE VIII.—OFFSPRING VARIABILITY ACCORDING TO PARENTAL
DEVIATION FROM THE MEAN

<i>Parents' Scores</i>	<i>Stanford-Tested Offspring</i>		<i>Alpha-Tested Offspring</i>	
	<i>N</i>	<i>S.D.</i>	<i>N</i>	<i>S.D.</i>
−.30 σ to +.30 σ	105	.87	99	.81
−.30 σ to −.90 σ	94	.89	98	1.01
+.30 σ to +.90 σ	61	.97	67	.84
−.90 σ to −.150 σ^*	98	.89	69	.98
+.90 σ to +1.50 σ^*	53	1.11	55	.84

* Groups beyond 1.50 σ were not included because of the insufficient number of cases.

might result in restricted variation of offspring—but somewhere between the central tendency of the group and the extremes.¹ So much for theory; what has been found in fact?

The first fact is that, as Pearson noted in the case of physical traits, the supposed changes in the variability of offspring from parents at different levels of a given quantitative trait “have not hitherto been noticed in inheritance tables” (17); Pearson also added:

Should the standard deviations of these arrays show . . . only the fluctuation to be expected from random sampling [instead of the hypothesized trend], we should have a strong argument against the present general theory of alternative inheritance. (p. 68)

¹ A formal mathematical proof of the relation between number of ‘allogenic’ genes (pure recessive couplets, such as *aa*, *bb*, *cc*, and so forth) and variation of offspring, under the condition of random mating, has been presented by Pearson (17).

Pearson wrote these words in 1904, assuming complete dominance; genetic theory has advanced remarkably since that date, yet the view that Pearson expressed then remains not without relevance and justice today.

In our own data, we have, like Pearson, "not noticed" any shift in variability among offspring from different classes of parents. Actual calculation of the variability of offspring, classified according to parental deviation from the mean, yields the results shown in Table VIII. The theory of a rising trend in variability of offspring, accompanying deviation of the parents from the mean, receives little or no support from this table. Since Outhit (16) has presented her original data, it is possible to verify this finding by carrying out similar calculations for her sample; this we have done with the outcome shown in Table IX. Here it appears that variability of offspring actually decreases, rather

TABLE IX.—OFFSPRING VARIABILITY ACCORDING TO PARENTAL
DEVIATION FROM 100 IQ
(Based on data of Outhit)

Parents' IQ Scores	Offspring	
	N	S.D.
95 to 104	62	14.4
85 to 94	85	13.4
105 to 114	88	13.1
75 to 84	44	11.5
115 to 124	77	13.2
125 to 134	90	13.2

than increases, as the parental group departs from the region of the racial mean (100 IQ).¹ *The results of Tables VIII and IX, then, appear*

¹ Conceivably the present human race is, through natural selection or some equivalent process, more intelligent than original members of the species, and correspondingly more highly laden with recessive factors. If so, the parents with *low* intelligence scores should be more dominant than those with scores equal to, or above, the average; and the offspring from such low-scoring parents should, according to theory, not only be less variable, but also exhibit less regression to the (present) mean. We are not aware of evidence supporting either of these possibilities.

definitely contrary to the theory of complete dominance, and, in proportion, also to the theory of incomplete or partial dominance. This conclusion is, of course, dependent on the assumption that parents farther away from the race-mean are definitely more recessive-laden than parents at or near the mean.

In summary, (a) the equality of empirical correlations for sibling versus parent-offspring resemblance in intelligence is not contrary to the theory of dominance, provided that the marital correlation in intelligence is fairly high ($\mu = .50$ or more). On the other hand, (b) the failure of offspring variability to increase with increase in the deviation of parents' scores from the mean is inconsistent with the theory of dominance, provided one assumes (as seems necessary to explain regression) that departure of parents from the mean of the race is associated with increase in the proportion of recessive genes. This inconsistency with the theory of dominance appears especially challenging in view of the vast body of genetic research on which the concept of dominance rests.

e. *Fisher's Formulas.* The theory of blending inheritance leads to theoretical familial *r*'s for intelligence that are definitely *higher* than those found in fact; the assumption of complete dominance (in conjunction with unassortative mating) led Pearson (17) to familial *r*'s for physical traits definitely *lower* than those found in fact; can a theory of partial or incomplete dominance (without the assumption of unassortative mating) lead to satisfactory agreement?

The correlational consequences of differing degrees either of dominance¹ or homogamy can be readily determined by simple formulas brilliantly devised by Fisher (7). The general hypothesis underlying his formulas is that, in the absence of systematic, differential, environmental influences, only three factors need be considered in order to predict or explain the correlations between relatives; namely, the

¹ As a theoretical defense for the premise, in his formulas, of various possible degrees of dominance, Fisher (7) writes: [Italics ours] "It is true that dominance is a very general Mendelian phenomenon, but it is purely somatic, and if better agreements can be obtained without assuming it in an extreme and rigorous sense, we are justified in testing a wider hypothesis" [that is, an hypothesis permitting partial dominance]. Fisher continues: "In the following investigation . . . the heterozygote is assumed to have *any value between those of the dominant and recessive*, or even outside this range, which terms therefore lose their polarity, and become merely the means of distinguishing one pure phase from the other." (p. 401)

marital coefficient (μ), random effects of environment (c_1), and the degree of dominance (c_2). Apart from the intricacies of the mathematical derivations, Fisher's method is to find, on the basis of the marital correlation (μ), the parental correlation (p), and the sibling or fraternal correlation (f) values of the two constants, c_1 and c_2 , such that the parental and sibling correlations are reproduced with minimal error. These values of c_1 and c_2 are then applied in other formulas, to predict other ancestral and collateral correlations, such as the grandparental, the avuncular, and the cousinship. *If the predictions of these other relations are correct* (within the sampling error), it may properly be said that Fisher's hypothesis and formulas have proved adequate in those respects, though not necessarily in all other respects.¹

The significance of Fisher's method, from the point of view of the heredity-environment issue in human intelligence, is that *it undertakes to account for the observed familial correlations on what is virtually a purely hereditary basis*.² The only environmental effects recognized in Fisher's formulas are the random influences represented by c_1 —'random' in the sense that they are uncorrelated with the hereditary value of the trait in question; that is, with the value of the trait in a 'standard' normal environment. For a trait extremely sensitive to only one or two environmental factors, these random influences could conceivably be of great importance, even to the point of determining death or survival within the species; but in the case of human intelligence, which is presumably only moderately sensitive to a rather wide variety of differential environmental factors, substantial counterbalancing of random influences is to be expected. If this be so, then c_1 , the only environmental factor in Fisher's formulas, is likely to be of only slight significance.

We would like to test the adequacy of Fisher's theory and formulas, but are unable to do so in the manner just indicated because we lack correlations for familial relations beyond the parental or fraternal³

¹ Even, however, for those respects in which the Fisher procedure proves adequate, it may still not be strictly valid—in the sense that the actual genetic mechanism may be quite different from that implied by the formulas. Evidence concerning the genetic mechanism is doubtless more safely sought from research in cytology and experimental breeding.

² In the present instance, the undertaking meets with some success.

³ Some data are, in fact, available to us on the avuncular and cousin relationship; but the correlations are based on a relatively small number of cases and will not be employed at the present time.

This is compensated for, however, by our independent (approximate) knowledge of the value of c_1 . Since, in the sample we are using, systematic environmental factors have not exerted any observable differential influence¹ (according to the criteria employed), it appears reasonable to suppose that the net effect of the random environmental factors must be very small, particularly since such random factors, as has been indicated, are likely to be substantially counterbalancing. It appears fairly safe, then, to assume that the value of c_1 is not very far from 1.00 (which is the value c_1 takes in the complete absence of random environmental effects), and probably not below, say, .95.

With the value of c_1 thus independently approximated, three tests of the adequacy of Fisher's formulas become possible.

1. We may compute the value of c_2 from the formula for the parental correlation, p , and predict the fraternal correlation, f ; the correspondence between predicted and actual values of f is a test of the adequacy of the method. (The alternative procedure—computing c_2 from the formula for f , and predicting the parental correlation, p —is equally possible, but will be omitted for the sake of brevity.)

2. We may compute the value of c_2 from either (a) the formula for the parental correlation, p , or (b) the formula for the fraternal correlation, f ; agreement of the values of c_2 from these two calculations would be confirmatory of Fisher's theory.

3. With the aid of the product of c_1c_2 (computed from the formula for p), we may calculate the value of c_1 from the formula for f ; agreement of the calculated value of c_1 with our independent estimate of its value provides the last test of the theory. In the treatment below, we shall apply the tests in the order named. Attention will be restricted to data from the present investigation only.²

¹ Were it not for this fact, Fisher's formulas would be inapplicable, since they take account only of environment defined as "arbitrary external causes independent of heredity" (7, p. 420).

² There are several reasons for this limitation. First, we lack the necessary information regarding the environmental factor in other available studies (*cf.* the preceding footnote). Second, cursory inspection indicates that similar conclusions would follow from application of the tests to Outhit's (16) data; and we are in doubt as to the general comparability of our data with Willoughby's (3), since Willoughby presents familial correlations for brief, single subtests only. Third, neither of the other available studies is based on so large a number of cases as the present investigation. Fourth, there are unfortunately practical limitations both of authors' time and of publisher's space.

1. By using the formula for parent-offspring correlation, we find $c_2 = .679$. Applying this value of c_2 in the formula for the fraternal correlation, we find $f = .507$, which is in good agreement with the empirical value, .49.

Before the fair agreement between predicted and actual values of the fraternal correlation may be taken seriously, however, it is well to ascertain that approximate agreement is not, for whatever reason, intrinsic in the Fisher formulas! We have, therefore, calculated f (in the same manner as above) on the assumption that $c_1 = .5, .6, .7, .8, .85, .9$, and 1.0 , respectively (as well as $.95$); the consequent values of f are listed in the following tabulation.

<i>Assumed Value of c_1</i>	<i>Consequent Value of f</i>
.5	.394
.6	.419
.7	.444
.8	.469
.85	.482
.9	.494
.95	.507
1.00	.519

The empirical value of the fraternal correlation, .49 is predicted fairly closely by assumed values of c_1 equal to .85 to .95. The upper value, .95, may possibly be regarded as a reasonable estimate of c_1 ; but we cannot regard as reasonable so low a value of c_1 as .85. We seem justified in concluding, then, that the fraternal correlation has been predicted, with *qualified* success, on the basis of Fisher's formulas. It must be noted, however, that such success as the formulas have had in the present instance springs not from application of the concept of incomplete dominance—our value of c_2 , .679, is practically identical with that for perfect dominance, or $2/3$ —but rather from the full and explicit recognition in Fisher's formulas of the influence of the marital coefficient, μ .

2. The second test involves the computation of c_2 from (a) the formula for the parental correlation, and (b) the formula for the fraternal correlation—again on the assumption, first, that $c_1 = .95$.

From the formula for the parental correlation we find $c_2 = .679$, as before. From the formula for the fraternal correlation, we compute $c_2 = .637$. These two values, .679 and .637, are in reasonably fair agreement.

But again it is desirable to inquire whether the reasonable agreement may not be more or less inherent in the Fisher formulas. As before, we have made calculations on the assumption that $c_1 = .5, .6, .7, .8, .85, .9$, and 1.0 . The consequent values of c_2 , as computed from p , are in reasonable agreement with its values as computed from f , when c_1 is taken equal to .85 to .95. The value .95 may possibly be considered a reasonable estimate of c_1 ; but the value .85 is too low. As before, then, we may conclude that the present data provide partial support for Fisher's formulas and his underlying theory, though certainly not full verification.

3. As a final test, we calculate the value of $(c_1 c_2)$ from the formula for p , and thence the value of c_1 from the formula for f . We are now making use, in the calculations, of empirical correlations exclusively; namely, of only p , μ , and f .¹ From such calculations we obtain $c_1 = .88$, a value definitely below our independent estimate of the value of c_1 , but by no means so far below as to justify casual dismissal. Our conclusion is, as before, that the present data provide partial, but certainly not unqualified, support for Fisher's formulas and their underlying theory.²

In evaluating Fisher's formulas and theory, it is necessary to remember that the empirical correlations employed in our tests are never, of course, without their sampling errors. It is impossible to know whether such errors have worked either for or against Fisher's hypothesis in the present instance. Yet we venture to suggest that the sampling error is a minor factor in the present case, since both f (the general sibling correlation) and p (the general parental) are based on a very considerable number of cases (f is based on 644

¹ It has been felt necessary to delete here and at several other points in this discussion formulas from Fisher or derivations from them. Readers who wish to follow the somewhat technical mathematical treatment in detail may secure assistance, if needed, by addressing the authors.—*Editor*.

² The three-fold test of Fisher's theory, just completed, may to some appear overextended, since the three tests are not independent. We consider it instructive, however, to view the situation from more than one angle; in addition, the concordance of results may offer some assurance that the Fisher formulas have been correctly applied.

individuals, comprising 777 sibling pairs; p is based on a total of 328 parents and 504 offspring).

The value of the marital correlation, μ , is less reliable, but accuracy in the value of μ is of only minor importance (7). Fisher has emphasized the special importance of an accurate value of f (7); this requirement is fulfilled in the present study.

Some further brief observations on Fisher's theory appear pertinent. First, the theory offers little help on the dilemma presented earlier, for if Fisher's $c_2 = 1.00$ (representing perfect blending), the objection concerning regression applies; if $c_2 = 2/3$ (representing perfect dominance), the objection concerning constancy of offspring-variability applies; whereas if c_2 is intermediate (representing incomplete dominance), the objection concerning regression may be met, but that concerning offspring-variability is not. Second, the assumption by Fisher (7) of a very large number of factors or genes, "sufficiently numerous to allow us to neglect certain small quantities" will probably appear questionable to some geneticists, who may consider this assumption of greater statistical convenience than biological verisimilitude. Third, and finally—what is perhaps ultimately most important—Fisher's theory seems to lack close contact with what have been thus far the two mainstays of the science of genetics; namely, cytological research and experimental breeding, nor has his theory produced helpful suggestions for such scientific work.

After all possible criticisms have been made, we must conclude that, at least as applied in the present instance, the Fisher formulas do have fair predictive power, that they do succeed moderately well in accounting for the observed familial relations in terms solely of the three factors, μ (the marital correlation), c_1 (random environmental effects), and c_2 (degree of dominance). The possibility remains, of course, that as good or better prediction might be achieved by giving weight also to systematic (differential) environmental factors; but the formal mathematical demonstration of this possibility has not yet been accomplished.

VI. SUMMARY OF METHOD, RESULTS, AND INTERPRETATIONS

1. Purpose

The purpose of the present study is to provide reasonably reliable determinations of the intelligence-resemblance between siblings and between parents and offspring. Such determinations are considered of basic importance; first, in providing an essential normative background; and second, in testing the validity of various hypotheses concerning environmental and hereditary influence.

2. Data and Sample

The present study is based on 997 cases in 269 family groups, constituting a representative sample of the rural population of a block of nine counties in central New England. Two tests of intelligence were employed: the Stanford-Binet (1916 revision, unabbreviated), for cases between 3½ and 14 years of age; and the Army Alpha test for cases aged 10 or over (either or both the Stanford-Binet and Army Alpha were applied in the age range 10 to 14).

All cases in the present sample are native born, and, with only few exceptions, of old New England stock. In these old American rural districts, cultural tradition is fairly uniform and stable; variation in economic status and educational opportunities is definitely more restricted than in a typical urban community.

3. Statistical Technique

The essential element in the statistical procedure is the conversion of raw Stanford-Binet and raw Army Alpha test scores into at-age

sigma scores by use of the formula, $x = \frac{X - Md_1}{\sigma_1}$, where X stands

for raw score, and Md_1 and σ_1 represent the (smoothed) median and standard deviation of scores on the Stanford-Binet or Army Alpha for cases in the individual's chronological age group. The median was preferred to the mean, because of a perceptible positive skew in the Army Alpha scores and, to a lesser extent, in the Stanford-Binet scores.

Familial resemblance was measured by use of the Pearson product-moment correlation. In the case of the sibling correlations, each correlation chart was rendered symmetrical by the customary 'double-entry' technique; but in order to avoid apparent over-statement of the actual number of sibling pairs, only the 'undoubled' number of sibling pairs is reported in the tables of the text. The tables also contain, for each sibling correlation, (a) the number of families, and (b) the number of individual cases upon which the given number of sibling-pairs is based.

4. Statistical Results

a. *Correlations between Siblings.* Fraternal correlations for like-sex siblings, opposite-sex siblings, and total siblings, classified accord-

ing to test employed (Stanford-Binet and Army Alpha), are presented in Table III. For the total Stanford-tested group, the sibling correlation is .50 (based on 312 pairs); for the total Alpha-tested group, .48 (based on 322 pairs); the correlation in the total group without regard to test employed is .49 (based on 777 pairs). If correction is made for attenuation, the correlation for Stanford-tested sibs is approximately .54, and for Alpha-tested sibs, approximately .51. Interpretations of the facts in Table III are summarized further on.

b. Parent-Offspring Correlations. Correlations between parents and offspring, for (a) Stanford-tested offspring, and (b) Alpha-tested offspring, are presented in Table V. The total Stanford-tested offspring with their parents yield 501 parent-child pairs; for these, the parent-offspring r is .49. The total Alpha-tested offspring with their parents yield 441 parent-child pairs; for these, the parent-offspring r is also .49. Additional correlations, for parents and offspring divided according to sex (husbands, wives, sons, daughters), are also presented in Table V; these correlations fall equally on either side of .49. Corrected for attenuation, the general parental correlation for Stanford-tested offspring (without regard to sex of either parents or offspring) is approximately .53; for Alpha-tested offspring, approximately .51. These figures are virtually identical with those for the general sibling correlation. Table V is interpreted in what follows.

5. Interpretations

Interpretations are offered with regard to the evidence on (a) environmental influence and (b) genetic mechanism.

a. Environmental Influence. (1) Evidence from Parent-Offspring Correlations. For the Stanford-tested offspring, the average of the mother-child correlations is substantially the same as the average of the father-child correlations (.49 and .50, respectively). Essentially similar results are obtained with the Alpha-tested offspring. It is concluded, after consideration of various supplementary hypotheses, that the data give no support for the view that the influence of the mother on intelligence of offspring exceeds that of the father.

(2) Evidence from Sibling Correlations. From Table III it can be seen that the correlation between like-sexed siblings is by no means higher than between opposite-sexed siblings. It is clear that the environmental similarities presumably associated with similarity of sex

have failed to exert any differential effect on intelligence-resemblance in the present sample. Also indicative of the lack of important differential environmental influence is the fact that, despite apparent differences in environmental heterogeneity, the sibling correlation for the present sample is about the same as has been reported for many others.

(3) Evidence from Sibling versus Parental Correlations. According to no tenable genetic theory is the sibling correlation expected to be lower than the parent-offspring correlation. On an environmental hypothesis, the greater similarity of the conditions of development among siblings than among parents and offspring should be reflected in a higher sibling than parental correlation. But in the present sample, the general sibling and parental correlations are exactly equal. This equality is, moreover, fairly dependable, in view of the number of cases on which the general sibling and parental correlations are based.

(4) Conclusions with Respect to Environment. The uniformity of negative findings in the preceding paragraphs gives no support to the view that definite environmental effects upon intelligence have been concealed merely by fluctuations of sampling. Either of two general interpretations appears possible: (1) Environmental differences are without systematic differential effects on the development of intelligence in the present rural sample; this absence of differential effect may be a function, to some extent, of the limited difference between intrafamilial and interfamilial variation in rural cultural advantages. (2) Environmental factors in the present sample are influential to an unknown degree, but, on the average, are counterbalancing. Unfortunately, it is impossible to decide which of these suggested interpretations is the more valid, without consideration of evidence beyond the scope of the present investigation. All that can definitely be said is that, for such theories of environmental influence to which the facts of the present study appear relevant, no positive support has been found.

b. *Genetic Mechanism.* The results of the present study are shown to be definitely inconsistent with the theory of blending inheritance, since the regression of offspring to the mean is wholly unexplained by the blending theory, and since the empirical familial coefficients are much lower than would be predicted by this theory (in a sample with a marital coefficient of .52).

Hurst's theory—a modified 'blending' theory—is rejected both for its failure to accord with the known facts of regression and for lack of any satisfactory positive evidence in its favor.

The theory of sex-linkage in the inheritance of intelligence is briefly considered.

The variability of offspring whose parents are at or near the mean is shown to be essentially the same as that for offspring whose parents deviate considerably from the mean. This constancy of variability is difficult to reconcile with the view (suggested by the facts of regression) that parents at or near the mean in a given trait possess a comparatively high proportion of dominant genes for that trait.

Fisher's formulas for the correlation between relatives are critically considered and applied to the data of the present study. The fundamental hypothesis embodied in Fisher's formulas is that the observed familial correlations may be adequately predicted or explained by means of three factors; namely, the marital correlation (μ), random effects of environment (c_1), and degree of dominance (c_2). Since random environmental effects are normally of small importance (except possibly for a trait very sensitive to only one or two environmental factors), and since systematic environmental factors are not at all included in the formulas, Fisher's method amounts very nearly to an attempt to account for familial resemblances on a *purely hereditary basis*. In the present study, devoted to familial resemblance in intelligence, Fisher's formulas succeed moderately well, though by no means completely. Interestingly enough, the value of c_2 most nearly consistent with the observed correlations is about 2/3, which corresponds to the value of c_2 under the condition of complete or perfect dominance. Possibly equally good prediction might be achieved by formulas that, unlike Fisher's, would take systematic as well as random environmental influences into account.

6. A Concluding Comment on Information Needed

In closing the report on this study, we may question the view, expressed by one of the writers in a previous Yearbook of this Society (1), that family-resemblance studies have little to contribute of crucial value for the heredity-environment problem. On the negative side, it is clear that no theory of environmental or genetic influence can be accepted unless it meets the detailed facts of familial re-

semblance. On the positive side, it seems likely that, given data sufficiently reliable and detailed, the facts of familial resemblance can themselves serve as a source of useful hypotheses and insights. There is need, in our judgment, not only for what are termed experimental approaches to the heredity-environment problem, but also for additional 'mere' facts. We still lack definitive answers to such fundamental questions as whether or not fraternal twins are reliably more similar than ordinary siblings; whether or not the grand-parental, avuncular, or cousin relations are in accord with the coefficients to be expected by Fisher's formulas; whether or not familial correlations are greater among older than younger family members. It may be well to remind one's self that psychology, no less than physics, requires a background of fundamental norms or constants, without which neither theory nor practice can hope to follow their most rewarding course.

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CHAPTER VII

INFLUENCE OF THE NURSERY SCHOOL ON MENTAL GROWTH

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In attempting to evaluate the relative rôles of hereditary and environmental factors in the determination of individual differences in intelligence, many studies of several kinds have been made (6). The data, we believe, have indicated heredity to be the more important factor; however, evidence of significant environmentally induced changes in IQ is not lacking, as in Freeman (2), who reported that when 37 children averaging eight years of age were transferred from inferior homes to better foster homes they made in 4½ years a mean IQ gain of 5.3, which "would probably mean an actual gain of about 10.4 points," when certain technical corrections were made.

Since an early age of transfer to a good environment has been found favorable to gains (2), it would seem that investigations of the influences on mental growth of the nursery-school environment should be important. Here the environmental changes are frequently marked and the children are young when subjected to them. The studies already contributed from the nursery schools, however, present conflicting results. Some studies (1, 7, 9, 10, 11, 12), notably those by Wellman and her students, show significant and sometimes striking gains in IQ as a result of nursery-school experience; others (3, 4, 5) reveal little or no gain from presumably similar experiences. It would appear, then, that further studies in which the nature of the environmental influences are described are needed if the issue is to be settled.

I. THE NURSERY-SCHOOL GROUP AND THE CONTROL GROUP

This study, using the revised Stanford-Binet tests of intelligence, Form L, reports test and retest IQ's, preceding and following a term in nursery school, for a group of 30 children who attended the school

and for an equated control group of 28 children from the waiting list. For the nursery school the median interval between the tests was 5.5 months and the range, from 4 to 9 months; the corresponding measures for the control group were 5.3, and from 4 to 8 months. The period extended from approximately one month after entrance to one month preceding the spring closing of the school.

The two groups were equated for age, socio-economic status, home-habit training, and approximately for sex. The following tabulation, which shows the degree to which equating was accomplished on all these factors except sex, reveals differences between the groups, but seemingly not of significant amount.

<i>Traits</i>	<i>Nursery School</i>			<i>Non-Nursery School</i>			<i>Differences</i>	
	<i>Mean</i>	<i>S.D.</i>	<i>σm</i>	<i>Mean</i>	<i>S.D.</i>	<i>σm</i>	<i>Means</i>	<i>D/σd</i>
Age, months								
at first test	43.67	8.50	1.55	41.96	9.65	1.82	+1.71	.72
Socio-economic								
status	28.50	11.05	2.02	32.36	9.43	1.78	-3.86	1.43
Home-habit								
training	124.17	18.17	3.31	121.60	18.80	3.51	+2.57	.53

Socio-economic status is scored by a composite of arbitrary weights assigned to some factors determining general quality of home: size, furnishings, and special provision for children; education of parents; occupation of father; income; magazines; and children's play equipment. The ratings were obtained by the examiners who visited and interviewed the parents of the children.

Home training in routine habits, such as dressing, sleep, toilet, washing and bathing, management of playthings, regulation of social behavior, and stories and conversation were determined by having each mother answer an inventory of questions on these home practices and checking them as 'never,' 'occasionally,' or 'regularly' observed. These degrees of observance were scored 0, 1, and 2, respectively, and the total score was obtained by summation.

The nursery-school children included two groups, 10 from the Utah State Agricultural College Nursery School, for whom a \$30.00 per year tuition is paid, and 20 from a tuition-free WPA nursery school for children of parents whose income is below \$70.00 per month. Both

are supervised by the college Department of Child Development¹ and have similar aims and activities.

These aims are: (1) acquisition of social habits appropriate to a variety of situations; (2) developing of personal efficiency in routine habits with respect to clothing, eating, toilet, and resting; (3) incidental cultivation of a problem-solving attack in meeting new situations and in overcoming temporary obstacles; (4) acquaintance with their environment (in this case, being an agricultural college campus, it is one of great variety); and (5) increase in vocabulary as an indirect result of experience.

For the college group the school day is four hours; for the WPA school, six hours. Activities in which the children participate include: (1) indoor play with toys and equipment—crayons, beads, picture-books, blocks, tools, boards, and the like, for one hour; (2) stories, conversation, and music for 20 minutes; (3) excursions and outdoor play for one hour, using such devices as a playhouse, wagons, tricycles, sand, swings, and slides; (4) a noon meal occupying 30 minutes during which children help to some extent with the setting and clearing of the table; (5) a rest period for 20 minutes; (6) removing and putting on clothing, for which 20 minutes were allowed. These time distributions, allowing a margin of 30 extra minutes, are approximately correct for the college nursery school; for the WPA school, the extra two hours are used for napping following lunch; otherwise the allotments are about the same as in the college school.

The teachers were, for the college nursery school, two graduate student assistants in child development; for the WPA, four teachers and a cook all taken from the relief rolls. The latter were selected for aptitude and interest and were given one summer of training in adult education classes. The leader had had three years of experience.

Besides the teachers, the social environment of the children included also several undergraduate students in child development, who, as a part of their class work, observed the behavior of the children in the nursery schools. From 15 to 25 students visited the school three hours per week each six-weeks' period.

A graduate student and three seniors in child development did the mental examining. All had taken Frandsen's course in clinical psychology and a laboratory course for acquiring skill in using the Stanford-Binet tests, besides courses in general, child, and educational psychology. A demonstration of proficiency in testing was required before permission was given to examine the children used in the study. Only one examiner knew that the test results were to be used in this experiment; in most cases the second test for a child

¹To Professor Elsa B. Bate, head of the Department of Child Development, we are grateful for coöperation in conducting the study and for helpful suggestions in preparing the manuscript.

was administered by a different examiner, who did not know the IQ first obtained. One evidence of the reliability of the examinations is the correlation of .90 between pre- and end-administrations of the test for the entire group of 58 children.

II. THE STATISTICAL RESULTS

In view of the conditions described above for the nursery-school and non-nursery-school children, it would appear justifiable to attribute any differences in mental growth over the period between the tests to the influence of the nursery-school environment. The extent of this influence is revealed in the following tabulation.

<i>Test</i>	<i>IQ Range</i>	<i>Mean</i>	<i>S.D.</i>	<i>Difference in Mean</i>	<i>Diff./σd</i>
<i>Nursery-School Children</i>					
First	173 to 66	113.00	18.92		
Second	158 to 75	116.34	16.90	3.34	2.81
<i>Home-Control Children</i>					
First	144 to 96	116.82	12.55		
Second	154 to 95	117.35	13.10	.53	.49

While there was practically no gain (.53) in IQ for the control group, the nursery-school gain of 3.34 IQ points approximates the conventional criterion of statistical significance. The critical ratio of the difference in gains ($2.81/1.61=1.74$), however, fails considerably to meet this standard. Both groups might have been expected to show some effect of practice on the second test, perhaps 3 points (8). This possible gain, however, may be masked by slightly uneven standardization of the scale within the age range for repeated tests of the children in this study. Terman's children averaged 108.0 at 3½ years and 102.5 at 4 years (8). Assuming that with larger groups, a difference in gains between the nursery-school and control children ($3.34-.53=2.81$) would probably be statistically significant, it is still small compared to the "mean gain in six months' time of approximately six to eight IQ points" reported by Wellman (11) for children attending the preschool in the Iowa Child Welfare Research Station.

Individual gains are also relatively small when compared with the unusual gains cited by Wellman. One child, the case showing the

greatest increase among those observed by Wellman, increased his IQ from 98 to 167 between the ages of three and one-half and five years (10). The extent and direction of IQ changes in the present study are presented in the following tabulation.

<i>Direction of Change</i>	<i>Frequency of Change to the Amounts</i>			<i>Mean Change</i>	<i>Range of Changes</i>
	0-5	6-10	11-15		
<i>Nursery-School Children</i>					
Increases	9	8	2	6.5	0 to 15
Decreases	9	1	1	3.7	0 to —15
<i>Home-Control Children</i>					
Increases	7	3	4	6.4	0 to 14
Decreases	9	2	3	4.5	0 to —15

The tabulation shows that the majority of changes for both nursery-school and control children are 5 points or less and that the maximal increase or decrease is 15.

Similar analyses of IQ changes reveal no relationships to sex nor to original level of intelligence. Although the college nursery-school group is superior to the WPA group, there is no significant difference in the gains made by the two groups.

III. SUMMARY

1. A group of 30 children, aged 2 to 5 years, were tested with the Stanford-Binet intelligence test at the beginning of a term in the nursery-school and were retested after a median interval of 5.5 months of nursery-school training. A control group of 28 children with whom they were equated approximately with respect to sex, age, socio-economic status, and extent of home training were examined at about the same time.

2. As a result of the special nursery-school environment, the experimental group gained 3.34 IQ points, as compared with a gain of 0.53 point for the control group. The gain for the experimental group, although it approximates statistical significance, appears very small when compared with the whole range of individual differences in IQ resulting from both hereditary and environmental causes. Over a

longer period, and perhaps with a different nursery-school environment, of course, increases might be large enough to affect significantly the learning ability or capacity of preschool children for adjustment. The gain obtained over this admittedly short interval of nursery-school experience, however, does not exceed by a statistically significant amount the very slight increase made by the control group.¹

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¹The authors of this chapter submitted a table showing in detail the complete numerical data for each child in each group. We regret that it has been deemed necessary to omit this table. Readers interested to examine the data can doubtless arrange that with the authors.—*Editor*.

CHAPTER VIII: THE STABILITY OF MENTAL-GROWTH CAREERS

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Ten years ago the writer published the mental-growth curves of 33 infants and young children whose behavior development had been repeatedly appraised by clinical examinations. We have followed the subsequent careers of 30 of these children who are now in their teens or older. By comparing the earlier with the later findings, we can in retrospect determine the predictiveness of the first appraisals, many of which were made during the first year of life. This venture in self-criticism has cast some interesting light on the developmental diagnosis and prognosis of infant behavior.¹

I. A TEN-YEAR STUDY IN 'PREDICTION'

How consistent over a decade and more have been these mental-growth careers?

In no instance did the course of growth prove whimsical or erratic. The behavior biographies give clear evidence of a high degree of latent predictability, even in infancy. The consistency of behavior trends over more than a decade is most strikingly illustrated in six brothers and sisters born of the same father and mother, reared under the same roof, first examined at 4, 10, 12, 36, 60, and 84 months of age, and later examined between the ages of 12 and 21 years. Three of these siblings have clung unmistakably to a normal course of behavior development; the other three, just as decisively to a subnormal course.

¹The detailed findings are published in a volume entitled *Biographies of Child Development*, by A. Gesell, B. M. Castner, H. Thompson, and C. S. Amatruda (Hoeber: New York, 1939, 328 pp.). This volume includes case studies of the mental-growth careers of 84 infants and children, observed over a period of years by the staff of the Yale Clinic of Child Development.

The infant behavior pictures were unambiguously prophetic of the later growth careers. Nature never mixes up two such distinctive sets of growth potentialities—the one fully normal, the other feeble-minded. In this instance, inheritance was unquestionably the factor that produced such a thoroughgoing contrast in these two sets of mental-growth curves (Figure I).

Our series of growth studies embraced a wide variety of cases: average, retarded, superior, talented, defective, atypical; children suffering from physical complications, including glandular abnormalities,

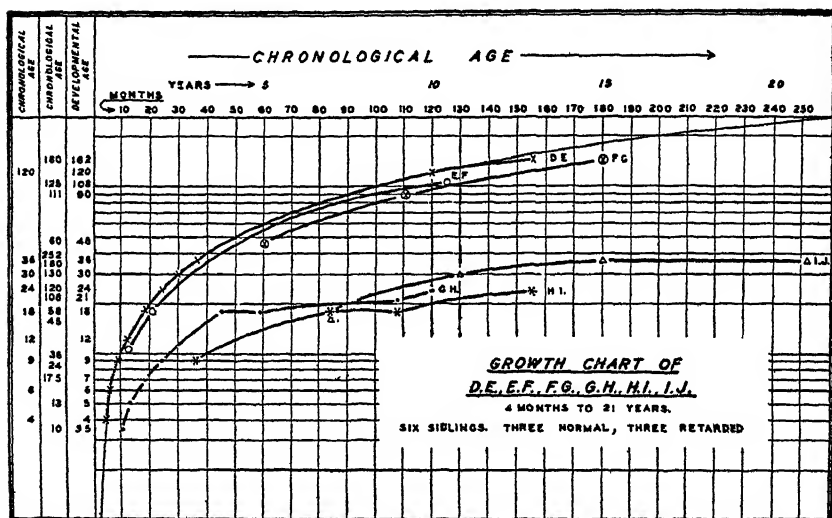


FIGURE I

birth injury, and prematurity of birth. Each child proved to have a distinctive growth pattern with a large measure of internal consistency. In only one case within the period of ten years was there a marked alteration of trend; namely, from a low-average to a high-average level (Child B.C., Figure II). In a few defectives there was a progressive retardation, without deterioration. For all others there was a general tendency to maintain a characteristic trend of mental growth. Improvement of trend occurs more frequently than decline.

The trend in every instance was clinically rather than psychometrically determined. We applied normative criteria, but we depended upon clinical appraisal to correct the errors inherent in unin-

terpreted intelligence quotients and developmental quotients. For infants and preschool children we regularly used the Yale norms of behavior maturity. On the basis of these norms we assigned a maturity level to each of four distinguishable fields of behavior: motor, adaptive, language, and personal-social.

After each examination new estimates of maturity were made, the records of the previous examination being taken into account. The previous records, however, were allowed to stand. They were not changed; they were simply reviewed. The examiner's problem each

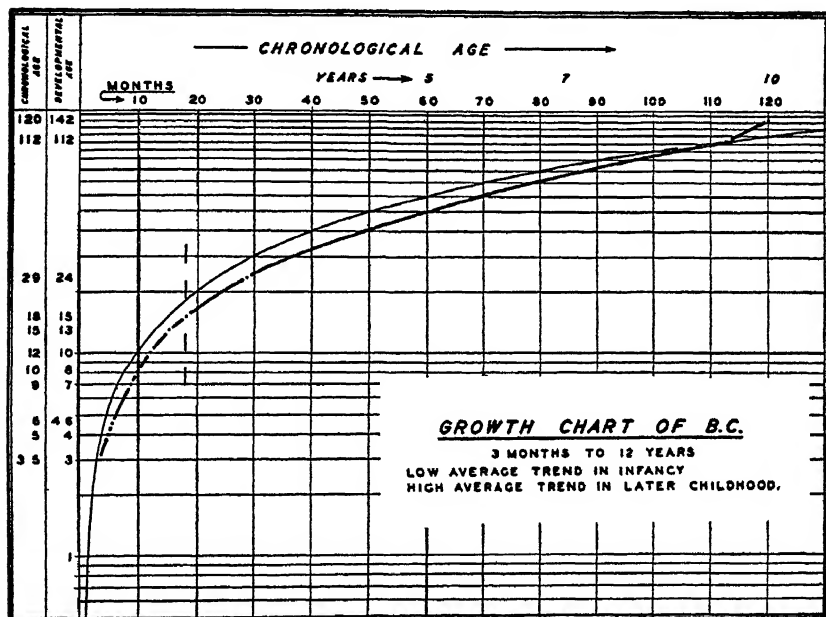


FIGURE II

time was to decide whether, in the light of all the data, the previous estimate could be confirmed, or whether it needed to be reduced or advanced in the new rating.

For graphic representation a general maturity level was clinically estimated after each examination. This was brought into ratio with chronological age as a 'developmental quotient,' or 'DQ.' For children of school age we used the Stanford-Binet IQ. Our graphs plot the quotients, but the detailed case records state our clinical appraisals,

which are by no means always identical with the psychometric quotients. These interpretive clinical judgments, we believe, have more scientific value than the raw quotients in investigating the consistency and the stability of mental-growth careers.

II. ILLUSTRATIVE CASES

We present briefly, the most significant data pertaining to 9 cases, along with 8 figures showing the developmental trends graphically.

Child O.P., at the age of three years was clinically adjudged to be distinctly superior because of the dynamic qualities of his performances, even though his initial intelligence score was not very extraordinary. On six annual examinations his drawing abilities proved equal to the average; his IQ's fluctuated widely: 115, 135, 140, 130, 165, 160. Our clinical estimates of his capacity, however, remained consistently favorable and did not undergo corresponding fluctuations. He passed his College Entrance Board examinations at age 16, after a superior record in preparatory school. He remains true to the superiority foreshadowed at age three (Figure III).

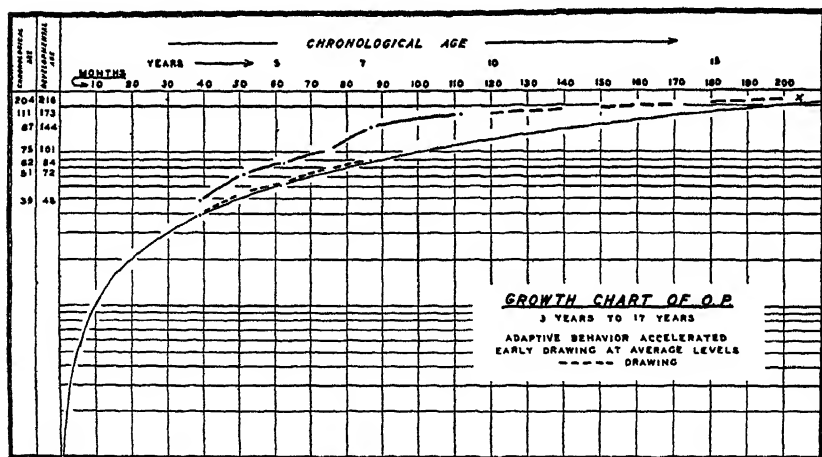


FIGURE III

In 1926 Baby J. K. was born, a son of undistinguished parents. At only two months of age he impressed the examiner with his alertness and responsiveness. At three months he was again examined. The favorable clinical impression was intensified. A cautious personality and ability forecast was entered into the record. Fifteen developmental examinations were made in

the interval between 2 months and 12 years. On every one of them he showed acceleration. At 12 years he has an average adult vocabulary. He has sustained the acceleration that was detected in early infancy. He exemplifies a consistent mental-growth career (Figure IV).

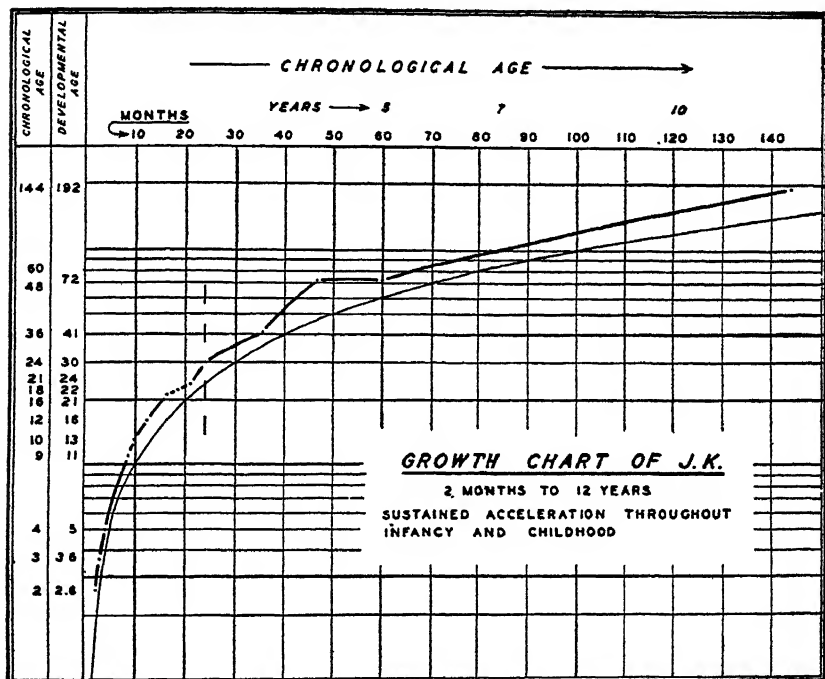


FIGURE IV

Child C. D., an orphan girl, has been under observation for 15 years. On the very first examination, at the age of 9 months, she was found to be moderately retarded; and, in spite of her attractive personality, was clinically classified as a borderline subnormal with a prognosis of continuing retardation. Ten subsequent examinations have fully confirmed this prognosis. The mental-growth trend and the temperamental traits have remained remarkably constant, in spite of the chequered environmental changes in institutions and in a succession of varied foster homes. School progress, intelligence ratings, and clinical estimates have all been in agreement (Figure V).

Baby L. M., a girl, displayed a vivid, vigorous, well-constituted personality throughout the preschool period. On six successive examinations from 9 months to 4 years, these favorable personality traits were noted, once even

after a debilitating illness. "Attention and adaptability superior" was written into the record at the age of one year. At 16 years these favorable dynamic qualities persist. She is highly intelligent, excels in language; her advanced language in infancy was prophetic.

Baby M. N. presented similar qualities in infancy, associated with an ordinary rate of development. At the age of 15 years she shows a superior critical sense in music. We did not make a specific prediction of musical talent; but reading backward we now find the following foreshadowing items. Age 3

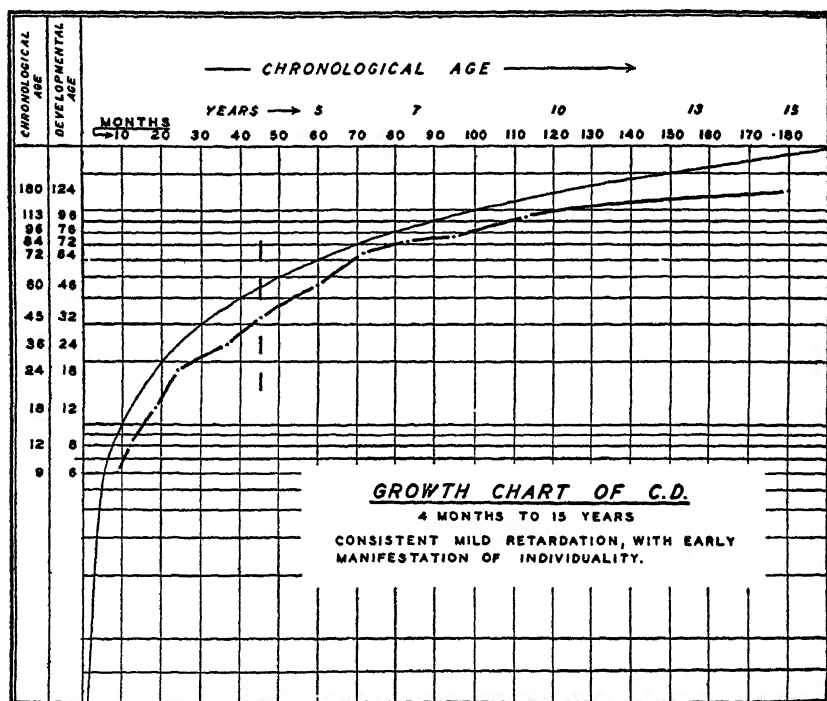


FIGURE V

months, "very sensitive to sounds," "sensitively attuned." Age 18 months, "Laughs, ha! ha! ha! ha! with the musical quality of a scale, each ha on a rising note." Age 30 months, "Marked ability to remember and to carry airs." These records permit at least retrospective prophecy!

Every individual appears to have certain growth potentialities primarily inborn, which impart characteristicness to his growth career. This is true of mediocre, superior, and even to a great extent, defective children. One of my

early clinical cases was a boy (C.E.) a little less than 13 years of age. He is now 36. He has grown in stature, but not in symmetry. The right-half of his whole physique, through faulty growth regulation beginning *in utero*, is conspicuously larger than the left, a rare case of unilateral gigantism. In spite of this physical anomaly, he has shown an incredible degree of constancy in his mental development. Between the ages of 12 and 36, he made a psychometric gain of one year, rising from a mental age of 4.5 years to 5.5 years. He reached a plateau at 20 and his psychological performance since then has scarcely varied by a jot or tittle. He is an example of impregnable developmental stability (Figure VI).

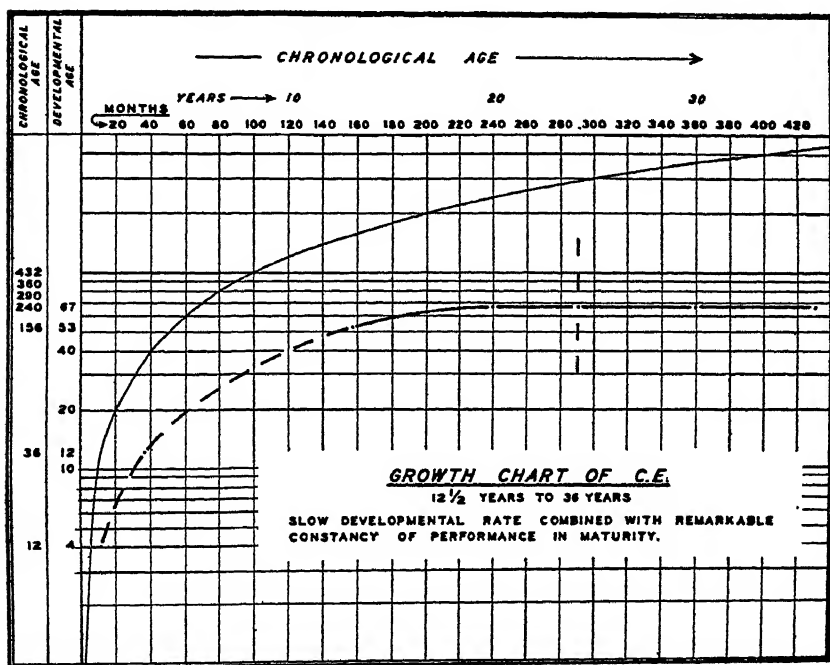


FIGURE VI

Even in cretinism the mental-growth career assumes coherence and consistency when the glandular deficiency responds to therapeutic treatment. Thyroxine supplies a necessary chemical growth regulator. Baby I.K., a girl, presented, at the age of 6 months, a picture of profound defect. Thyroid therapy was immediately begun and has continued through the subsequent 12 years during which she has consumed 1½ troy pounds of this powerful

chemical—thanks to which she has consistently maintained a mental-growth trend at a low sub-average level (median IQ 75). That trend hangs on a thyroid thread (Figure VII).

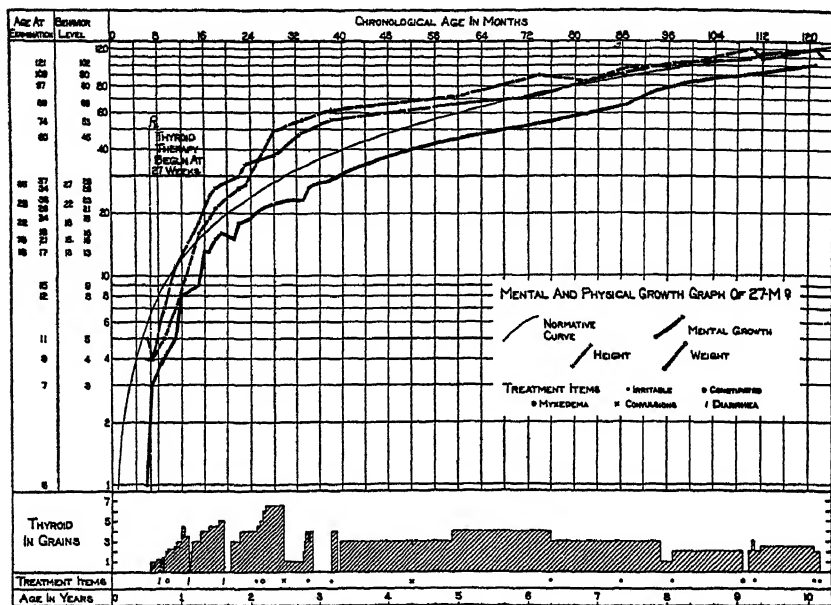


FIGURE VII

Equally significant of the mechanics of mental growth is a case of *pubertas praecox* that we carefully observed for a period of 15 years. This girl, H. J., reached physiological maturity (menarche) at the extremely precocious age of $3\frac{1}{2}$ years. She was markedly accelerated in height and weight, but never became an educational or conduct problem. She made ordinary progress through the elementary grades and junior high school and maintained an almost undeviating course of mental growth, appraised by 16 developmental examinations. So well protected were the determiners of psychological development that they remained virtually immune even though adolescence was displaced forward by a decade. Again a notable example of the intrinsic stability of mental-growth careers (Figures VIII and IX).

Premature birth, like premature puberty, alters the normal conditions of growth. Infant J. L., a boy, was born two months prematurely. Those two months do not count heavily now, for he is over 12 years old. But at the age of 5 months they depressed the behavior level to less than 3 months, with a

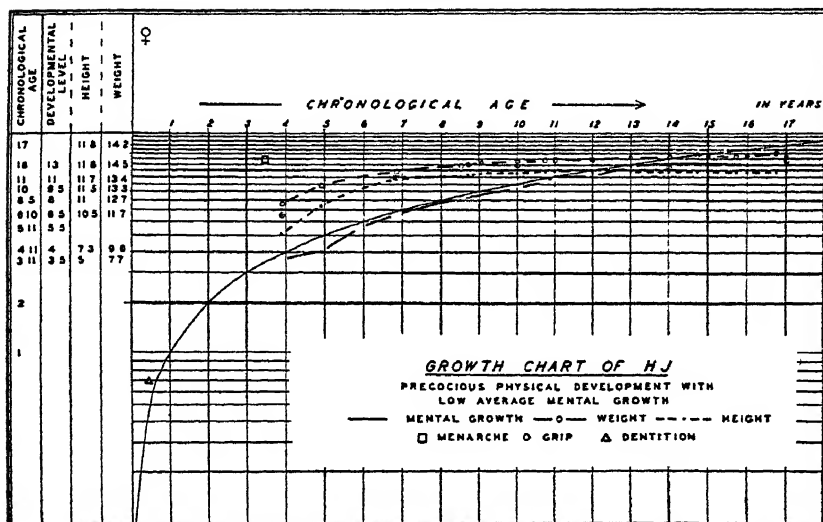


FIGURE VIII

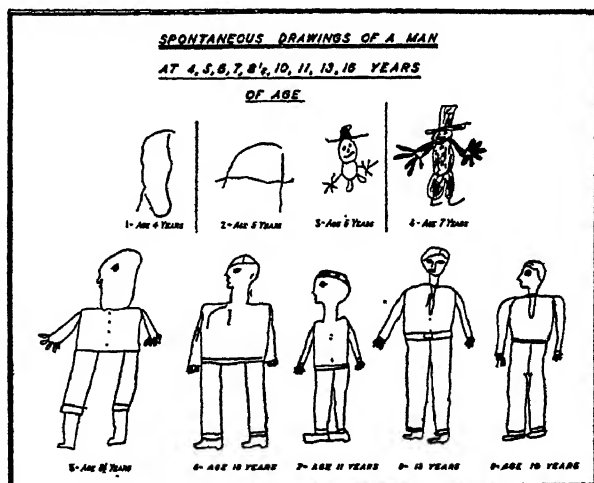


FIGURE IX

resultant DQ of 50, a retardation so grave as to require a diagnosis of feeble-mindedness, if taken at its face value. But in clinical appraisal one does not take a DQ or an IQ at face value. We made allowance for two months of pre-

maturity and made a clinical classification of border-line inferior, with relatively good personality make-up. The forecast was justified. He was examined on 9 more occasions; he has consistently maintained a subnormally retarded trend of mental growth (Figure X).

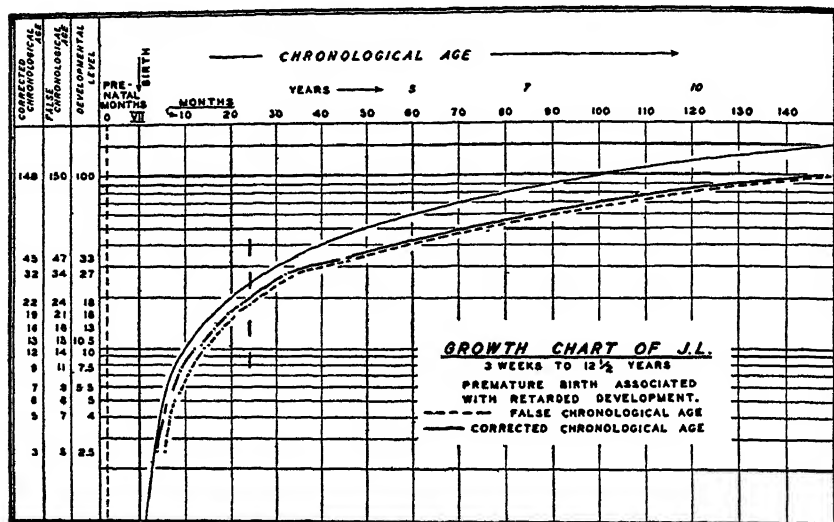


FIGURE X

III. MENTAL DEFECT IN INFANCY

The foregoing cases were selected from some 10,000 now on file at the Yale Clinic of Child Development. Numerous biographic case studies by members of the staff have strengthened the conclusion that the basic trends and tempo of behavior development, as a rule, manifest themselves in infancy. If a child has normal growth potentialities, it is almost certain that they will reveal themselves to clinical perception in the first two years of life. Temporary 'irregularities' of development are more frequently encountered throughout the preschool years, because of the nascency and interdependencies of behavior patterns during this formative period. In a few extremely exceptional instances, bound up with obscure emotional and physical factors, the signs of normality may be delayed as long as 3 years. On the other hand, virtually every case of primary feeble-mindedness can be diagnosed in the first year of life. In a wide clinical experience we have never seen a case of secondary feeble-mindedness due to edu-

cational or environmental deprivation, although we have seen an occasional case in which the IQ itself had descended to an apparently defective level.

A child should never be classified as feeble-minded on the basis of an IQ alone. Feeble-mindedness in the eyes of society is a medico-legal concept and demands a responsible diagnosis of the ultimate developmental outlook of the child. It is fallacious to conclude from IQ statistics that a child is made feeble-minded by poor environment or that a hitherto alleged feeble-minded child becomes normal through improved educational surroundings. Above all, in cases of child adoption, foster parents should not be permitted to think that a child of meager growth endowment can be brought up to full normality through a good home and nursery-school advantages.

IV. DEVELOPMENTAL ENDOWMENT AND INSURANCE FACTORS

In appraising growth characteristics, we must not ignore environmental influences—cultural milieu, siblings, parents, food, illness, trauma, education. But these must always be considered in relation to primary, or constitutional, factors, because the latter ultimately determine the degree, and even the mode, of the reaction to so-called 'environment.' The organism always participates in the creation of its environment, and the growth characteristics of the child are really the end-product expressions of an interaction between intrinsic and extrinsic determiners. Because the interaction is the crux, the distinction between these two sets of determiners should not be drawn too heavily.

When there is a fairly even balance between the endogenous factors and the sustaining, or exogenous, factors, the trends of mental growth, whether subnormal, superior, or mediocre, are likely to be most consistent. Developmental diagnosis and prognosis then come nearest to their mark. When, however, the organism is under stress of distortion, because of unfavorable conditions, then its ultimate adjustments, as expressed in growth characteristics, become least predictable. There are too many variables to appraise. External environment can be estimated with some shrewdness; but not so readily, the internal developmental reserves.

These hidden reserves are the intrinsic insurance factors that we have had to mention repeatedly in cases of atypical and irregular be-

havior development. The concept of insurance factors is not mystical. It is derived from experimental embryology and from clinical observation. The surgical excisions, transplantations, and other interferences with the growing tissues of laboratory embryos have demonstrated that the organism is protected with a remarkable fund of reserve mechanisms that promptly or gradually move into every breach and fill it in some way, either through regeneration, or through compensatory and substitutive growth. If the lesion is too great, the organism dies. If the lesion is not too severe, and the organism not too old, growth may continue in a normal manner.

In the development of the nervous system and in the ontogenesis of behavior, the human organism displays comparable insurance mechanisms. Locked in inner recesses beyond diagnostic scrutiny are reserve factors that may come to the rescue when development is retarded or impaired. As a poison stimulates the formation of antibodies, so certain errors or depressions of development stimulate a regulatory self-correction. These reserve factors, however, are not a single generalized capacity. They are specific biochemical and somatic structures, probably almost infinite in number and variety, and of many degrees of availability. They are present in defective, as well as in normal, individuals. They are probably most abundant in the most vital and best endowed. Vitality is an index of the plenitude and vigor of these very insurance factors. In spheres of behavior they operate not only during the period of growth, but also in old age; at least in the most 'vital' individuals.

If there is a principle of uncertainty in the physiology of development, it is a biological principle that rests upon important individual differences with respect to these insurance factors. Since they vary in amount, it is difficult to ascertain their strength in those inscrutable infants who present a picture of an inadequate, and yet not decisively defective, behavior. Here diagnosis must be wary, sometimes for a whole year or more, because sometimes the insurance factors come tardily and slowly into full force. But if they are present, and if the attendant conditions permit, they will ultimately assert themselves. When there is no counteracting deteriorating process, the tendency of growth will be toward something better and toward an optimal organization of the available equipment.

CHAPTER IX

THE MENTAL DEVELOPMENT OF NURSERY-SCHOOL CHILDREN COMPARED WITH THAT OF NON-NURSERY-SCHOOL CHILDREN¹

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and

KATHARINE M. MAURER

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I. SUBJECTS

Since its establishment in the fall of 1925, the Institute of Child Welfare of the University of Minnesota has been conducting an extensive series of studies in the field of mental growth. Although, since the first year, no special attempt has been made to compare the progress of children who attended the Nursery School with that of children who lacked this training, nevertheless the records of a large number of children who have been retested at intervals over the past 13 years provide the necessary material for such a study.

The data consist of the test records of 147 children who attended the Institute's Nursery School for periods varying from 40 to 575 days² and of 260 additional children who had no nursery-school training. The present study includes only those cases who have been given either the Minnesota Preschool Test or the Stanford-Binet at least twice with an interval between testings of at least one year. Many of these children have also been given one or more of the following tests: The Kuhlmann-Binet, the Merrill-Palmer Tests, or the Arthur Performance Scale, Form A. Until the fall of 1936 the 1916 Revision of the Stan-

¹ Assistance in the preparation of these materials was furnished by the personnel of Works Progress Administration Official Project No. 665-71-3-69.

² A total of 55 children have been eliminated from the study because of attendance records totalling less than 40 days per child. These children have not been included in either the nursery-school or the control group.

ford was used;¹ since then we have used the 1937 Revision, beginning with Form L and changing to Form M in alternate years. The findings from the three tests last mentioned will be reported elsewhere. Our reasons for disregarding them in considering the effect of nursery-school training are as follows:

First, the Kuhlmann Revision was used only up to the time when the work on the Minnesota Preschool Scales had reached a point at which the latter could be substituted for it; that is, for about a year and a half after the Institute was established. The effect of one year of nursery-school training as indicated by the use of this scale has already been reported.²

Second, the Merrill-Palmer Tests have been given to practically all the nursery-school children at least once; to many they have been given annually. Because of the practical difficulty of having parents bring small children to the Institute for too many tests within a single year, only a small number of children not in attendance at the school have been given these tests. A comparison of the groups would therefore be based on too few cases to be reliable. Moreover, at least for our superior group of children, the test is too easy to provide an accurate measure of ability after the age of four and, therefore, does not cover the entire period of attendance at nursery school.

Third, the Arthur Performance Scale is not suitable for children under the age of five; hence, it cannot be used as a measure of initial status. Moreover, the content of the test as well as the method of scoring are sufficiently different from those of the other tests considered for the results to be strictly comparable. It may be added that for our subjects, at least, the intelligence quotients earned on this scale run appreciably higher than those earned on the Binet in most cases.

The children reported upon had never been tested before the administration of the first test here considered, which was in all cases the Minnesota Preschool Scale. This meant the further elimination from the main study of 20 nursery-school and 29 non-nursery-school children who had been given the Merrill-Palmer Tests previous to the first administration of the Minnesota Preschool Tests, and of 56 nursery-school and 215 non-nursery-school children who were first tested by means of the Kuhlmann Revision. Because of the slight facilitating effect that previous experience in the mere taking of a test

¹ By special arrangement with the authors, we were enabled to make the change to the new revision a few months in advance of its publication.

² See F. L. Goodenough. "A preliminary report on the effect of nursery-school training upon the intelligence-test scores of young children." *The Twenty-Seventh Yearbook, Part I*, of this Society, 1928, pp. 361-369.

TABLE I.—DISTRIBUTION OF CASES IN NURSERY-SCHOOL AND CONTROL GROUPS BY OCCUPATIONAL CLASS AND AGE AT INITIAL TEST

Occupational Group	Nursery School					Non-Nursery School				
	Age, Months					Age, Months				
	Cumulative Percentages					Cumulative Percentages				
	18 to 29	30 to 47	48 to 59	Total		18 to 29	30 to 47	48 to 59	Total	
I	13	28	12	53	36.1	19	40	15	74	28.5
II	10	12	5	27	54.5	13	21	16	50	47.7
III	5	17	5	27	72.9	29	47	12	88	81.6
IV	17	14	3	34	95.9	13	12	8	33	94.3
V	1	0	0	1	96.6	0	2	3	5	96.2
VI	1	1	3	5	100.0	6	3	1	10	100.0
Total	47	72	28	147	100.0	80	125	55	260	100.0

* See F. L. Goodenough. *The Kuhlmann-Binet Tests for Children of Preschool Age: A Critical Study and Evaluation.* (University of Minnesota Press: Minneapolis, Minn., 1928) 146 pp.

appears to have on the later test performance of young children, even though the second test be different in content from the first, we have preferred to maintain greater uniformity of testing conditions, at the cost of lessening the size of the groups. In this we have been guided by Thorndike's dictum: "One does not get rid of mistakes merely by making a great many of them."

TABLE II.—MEANS AND STANDARD DEVIATIONS OF INITIAL IQ
ON THE MINNESOTA PRESCHOOL TEST*

Occu- pational Group*	Age, Months							
	18 to 29		30 to 47		48 to 59		Total	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
<i>Nursery School</i>								
I	109.4	5.7	115.9	10.4	111.3	14.7	113.3	11.1
II, III	109.2	12.5	111.5	10.9	107.0	14.4	110.0	12.2
IV, V, VI	106.7	14.6	105.8	14.1	108.3	8.9	106.6	13.7
Total	108.2	12.1	112.0	12.0	109.1	13.7	110.3	12.5
<i>Non-Nursery School</i>								
I	109.6	10.9	113.8	11.1	109.2	10.4	111.8	11.1
II, III	106.2	11.2	106.4	13.1	113.0	16.2	107.7	13.5
IV, V, VI	99.9	20.2	105.7	14.6	98.3	7.6	101.6	16.2
Total	105.5	14.2	108.7	13.2	108.8	14.4	107.7	13.9

* For number of cases in each group, see Table I.

The children as a group are above average in intellectual status and in home background. This is apparent from Table I, in which the cases are classified according to the occupational level of their fathers,² and from Table II, in which the means and standard deviations of intelligence quotients earned on the initial tests are classified by age and occupational grouping.

²F. L. Goodenough. *The Kuhlmann-Binet Tests for Children of Preschool Age: A Critical Study and Evaluation*. (University of Minnesota Press: Minneapolis, Minn., 1928) 146 pp. (See especially Appendix A and pp. 46-49.)

While the general superiority of the group is in part to be accounted for by the overweighting with children from the upper occupational levels, Table II shows that the average intellectual level of the children from the lower socio-economic levels is superior to that of the general population. This is especially true of the nursery-school children and suggests that some selective influence has operated to favor the inclusion of the better-endowed children from the lower classes and to exclude those of lower ability.¹ This influence is almost certainly operative. First, it has been the policy of the school not to admit children whose test results and general behavior indicated that they were feeble-minded, since we had no suitable facilities for their training and they did not fit in well with the normal children. Second, as might be expected, there has been a greater tendency for the children of the less intelligent parents to drop out of the group after a relatively brief period of time, either through loss of interest or moving out of the district. Since Table I includes only those cases with whom we have maintained contact for at least a year, it is evident that the more transient residents are automatically excluded. Upon the whole, these will tend to be the less able members of a given occupational class. Third, and probably of chief importance, is the fact that for the past few years the nursery school has been run on a tuitional basis.² This has not only increased the proportions from the upper socio-economic levels but has also added to the likelihood that the children whose fathers are classified in Group III or lower actually come from homes better than the average of those groups. As a matter of fact, the class distinctions appear to have been largely abolished by the financial hurdle. For the children of our present group (1938-1939) the following initial IQ's were obtained on the Minnesota Pre-school Scale: for 17 children in Occupational Class I, the mean IQ was 119.9; for 12 in Class II, 120.0; for 3 in Class III, 120.8; and for 1 in Class V, 117.

¹ Since the initial tests were always given either just before or shortly after admission to the nursery school, this superiority cannot be accounted for on the basis of nursery-school experience.

² During the first years of its organization from September, 1925, to February, 1933, the nursery school was entirely free. After that, new registrants were charged a tuition of \$60 a semester.

II. PROCEDURE

1. The Examiners

All tests have been given by members of the psychometric staff of the Institute under the direction of the senior author. The staff includes one full-time and one half-time psychometrist who do no nursery-school teaching. At times, they have been assisted by research assistants who have previously been trained in testing at the Institute, but the number of tests given by the latter is small. At no time have any of the nursery-school teachers taken part in the testing. This is a matter of some importance when results are to be compared with outside cases, since with these small children, the child's acquaintance with the examiner and the latter's intimate knowledge of the personal idiosyncracies, the likes and dislikes, of the child and the best ways of arousing his interest may well operate to create a situation that is far more favorable to securing a maximal response from the nursery-school children than from a control group with whom they are unacquainted. Our testing laboratories are located in the nursery-school building but on a different floor, to which the children come only for mental and physical examinations. Their acquaintance with the examiner is commonly limited to the testing situation.

With one exception¹ all examiners were given a period of preliminary training by the senior author before entering upon their regular duties regardless of the amount and kind of previous instruction that they might have had. Thus, in spite of the fact that the tests have been given by a number of different persons, it is believed that there have been no fundamental changes in manner of administering or of scoring the tests.

2. Avoidance of 'Halo Error'

As has been pointed out elsewhere in this Yearbook,² the flexibility of procedure so necessary in administering a Binet test opens the way to many small variations in test administration, which, especially in the case of young children, may affect results to an extent that few who have not had extensive experience in the testing of little children can realize. There have been many studies of the so-called 'halo

¹The exception noted above was the case of Miss Barbara Mayer, who for the seven years immediately preceding had worked with Terman and Merrill on the standardization of the new Stanford-Binet Scale. Our change from the 1916 revision of the Stanford to the new revision was made at the time that Miss Mayer came to the Institute as psychometrician. In her case the usual procedure was reversed, since it was she who provided the training in the use of the new scale to other members of the staff.

²See Part I, Chapter XI.

effect' upon ratings; but the possibility of a similar halo resulting from *knowledge of a child's standing on a previous test* or other facts that predispose the examiner to expect him to do well or to do poorly has been little investigated. Yet any fair-minded and experienced examiner will agree that this factor may be a very real source of error in testing, unless definite attempts are made to bring it under control. During the first year of the Institute's organization, recognition of this possibility led us to lay down an inflexible rule to which we have steadily adhered. *No examiner is ever permitted to look up the results of a previous test before administering a retest.*

Names and addresses of the children are kept in a separate master file, which includes no information except (a) child's name, address, and telephone number, (b) parents' name, (c) child's date of birth, (d) month and day when he is due for testing,¹ (e) the kind of test that he is scheduled to have (as for example, New Stanford, Form L), and any special notes that may be useful in making the appointment. These cards contain no information whatsoever as to previous test standing, nor do they indicate whether or not the child in question had previously attended nursery school. Although it is true that the fact last mentioned was always and unavoidably known to the psychometrician who made the examination as long as the child was actually enrolled in our nursery school, it was rarely known in the case of the older children, since no examiner has remained in the position for more than two or three years, and there has been nothing in the nature of her dealings with the children that would provide her with this knowledge unless her term of service overlapped with the child's attendance. It is safe to say that in at least 80 percent of the tests given to children past the age of six or seven years, the test was given without knowledge of whether the child had or had not had nursery-school experience. It is likewise safe to assume that prejudgment of the child's ability has been a very minor factor in influencing test results, although it is probable that during an examiner's second or third year of service it has occasionally happened that some memory of an individual child's previous level of performance may have survived the year's interval, in spite of the many other children she had tested in the meantime.

3. Motivation, Recording and Checking Responses

Every effort has been made to secure maximal response on the part of every child tested. In the case of young children who were unus-

¹ Children come to the Institute for their annual tests on the date half way between birthdays, or as close to this date as an appointment can be arranged for. The divergence from the accepted date rarely exceeds a month in either direction, and usually does not exceed a week.

ually diffident or negativistic, this rule has frequently meant that the child was not tested on his first visit to the Institute. Instead, the first visit was made an occasion for getting him acquainted with his surroundings and with the examiner and in accustoming him to carrying out simple directions in a spirit of play, by way of preparation for the test that was to follow. A second appointment would then be made, usually for the following day, at which time excellent coöperation could be secured in nearly all cases. If, however, in spite of all reasonable effort, the test still proved to be unsatisfactory, it was not included in the child's record. The cases finally included therefore comprise only those which, as far as the examiner was able to judge, approximated the child's best level of performance. It should not be forgotten, however, that even an experienced and skilled examiner cannot always tell when a child's wrong answers are due to factors other than lack of ability or when his right answers are partly due to fortunate guessing. Particularly in the case of young children who are not motivated by a desire to excel, the margin of error involved here may be rather large.

The child's exact responses have in all cases been recorded in detail on the test blanks. These records have been carefully checked for mechanical accuracy of scoring the responses and in computing mental ages and intelligence quotients. This sort of checking is important in any study of this kind, because some errors are likely to be found on rechecking, however experienced and careful the examiner may be.

Tests were scheduled at an hour that would interfere least with the child's regular activities and habits. As far as possible, the younger children were tested in the morning since little children are likely to be much less responsive after waking from their afternoon nap. Older children were not urged to come for their tests on days when they had made other special plans, the breaking of which would have involved a disappointment to them. Every effort has been made to make the annual visit to the Institute something to which each child looks forward with pleasure.

III. RESULTS

Tables III, IV, and V summarize the changes in standing on the Minnesota Preschool Tests for nursery-school children after one, two, and three years of school experience and for non-nursery-school chil-

dren after corresponding intervals of time. Unless otherwise stated, no table includes cases not also included in Table I, but some chil-

TABLE III.—CHANGES IN MEAN IQ ON THE MINNESOTA PRESCHOOL TEST
AFTER ONE YEAR OF NURSERY-SCHOOL TRAINING, COMPARED
WITH CHANGES FOR NON-NURSERY-SCHOOL CHILDREN
AFTER A YEAR'S INTERVAL

	<i>Nursery</i>			<i>Non-Nursery</i>		
	<i>Months Old at Test 1</i>			<i>Months Old at Test 1</i>		
	<i>0 to 29</i>	<i>30 to 59</i>	<i>Total</i>	<i>0 to 29</i>	<i>30 to 59</i>	<i>Total</i>
OCCUPATIONAL GROUP I						
Cases	5	26	31	9	23	32
Test 1	108.5	114.4	113.5	108.6	114.2	112.7
Test 2	117.5	120.2	119.7	117.5	119.5	118.9
OCCUPATIONAL GROUPS II, III						
Cases	6	22	28	22	42	64
Test 1	109.2	111.4	110.9	103.2	107.6	106.1
Test 2	115.8	113.4	113.6	105.5	111.9	109.7
OCCUPATIONAL GROUPS IV, V, VI						
Cases	15	10	25	9	17	26
Test 1	108.5	106.5	107.7	108.1	103.7	105.2
Test 2	113.8	110.0	112.3	109.2	110.7	110.2
TOTAL GROUPS I-VI						
Cases	26	58	84	40	82	122
Test 1	108.8	111.9	110.9	105.5	108.4	107.6
Test 2	115.0	115.7	115.5	109.3	113.8	112.2

dren have been eliminated from each comparison for one or another of the following reasons:

1. Since Table I summarizes records up to the spring of 1938, it is evident that many children at that time would not yet have reached the age or extent of training necessary for inclusion.

2. Owing to factors beyond our control, such as temporary illness, or family complications that made it impossible to administer an annual test when

scheduled, the test for a given child for a given year sometimes had to be omitted.

3. A few children from both groups moved from the city or their parents lost interest. A small number of children have died.

4. For good reasons some children were given other tests, but not the Minnesota test, on certain years. We have thought it wiser to omit these cases than to attempt to combine scores for different tests. Again, in both groups it sometimes happened that the annual test was not given by the

TABLE IV.—CHANGES IN MEAN IQ ON THE MINNESOTA PRESCHOOL TEST
AFTER TWO YEARS OF NURSERY-SCHOOL TRAINING COMPARED
WITH CHANGES IN NON-NURSERY-SCHOOL CHILDREN
AFTER AN INTERVAL OF TWO YEARS

<i>Occupational Group</i>		<i>Nursery</i>	<i>Non-Nursery</i>
I	Cases	15	9
	Test 1	110.8	114.2
	Test 3	118.5	124.2
II, III	Cases	19	15
	Test 1	108.0	107.5
	Test 3	114.9	112.5
IV, V, VI	Cases	17	5
	Test 1	106.0	118.5
	Test 3	112.5	112.5
Total	Cases	51	29
	Test 1	108.9	111.5
	Test 3	115.1	116.1

regular Institute psychometrist but by a student in training. These cases have not been included. The only tests not given by the regular examiners that have been used in this study are those given by research assistants who had previously completed their training in mental testing.

The number of cases included in Tables IV and V is further restricted by the fact that many children never receive more than one year of nursery-school training and that three years are possible only if the child enters at the age of two, since transfer to the kindergarten is made automatically at the age of five, and children of advanced physical and mental development are often promoted to the kindergarten at an even earlier age.

Table II shows that at each age and occupational level the nursery-school children slightly exceed those not attending nursery school at the time of their initial test. This indicates that some selection within the various occupational levels has occurred. As already mentioned, children who are sent to our nursery school are not entirely representative of the occupational level in which they are classed but are more

TABLE V.—CHANGES IN MEAN IQ ON THE MINNESOTA PRESCHOOL TEST
AFTER THREE YEARS OF NURSERY-SCHOOL TRAINING COMPARED
WITH CHANGES IN NON-NURSERY-SCHOOL CHILDREN
AFTER AN INTERVAL OF THREE YEARS

<i>Occupational Group</i>		<i>Nursery</i>	<i>Non-Nursery</i>
I	Cases	5	5
	Test 1	105.5	113.5
	Test 4	121.5	124.5
II, III	Cases	5	8
	Test 1	109.5	105.6
	Test 4	112.5	106.9
IV, V, VI	Cases	3	2
	Test 1	117.5	125.0
	Test 4	110.8	122.5
Total I to VI	Cases	13	15
	Test 1	109.8	110.8
	Test 4	115.6	114.8

likely to be drawn from the upper than from the lower part of its range. The occupational classes are numbered here according to the six-fold grouping that was used in a previous study on the reliability of the Kuhlmann-Binet¹ with no class for rural children. The designations for the six groups are as follows:

- Group I Professional.
- Group II Semiprofessional and managerial.
- Group III Retail business, clerical, and skilled trades.
- Group IV Semiskilled trades and minor clerical.
- Group V Slightly skilled trades.
- Group VI Unskilled occupations. Day labor.

¹For reference, see F. L. Goodenough, *The Kuhlmann-Binet Tests for Children of Preschool Age*, detailed in a previous footnote.

Table III shows that, at the end of one year of nursery-school training, the nursery-school children show an average gain of 4.6 IQ points, and that this is precisely the gain made by the non-nursery-school children after a corresponding period of time. For young children, the effect of previous experience in taking a test has commonly been found to be somewhat greater than it is for older children, probably because the experience involves a greater number of unusual elements. We know of no reason for this gain other than the undefined factors that may be subsumed under the heading of 'practice effect,' a practically invariable feature of all psychophysical measurements.

In Tables IV and V (two years and three years of interval) we see the beginning of a new factor. That is the lessened stability of our contact with the children of the control group. However, the apparent marked falling off in the number of cases does not indicate the true amount of elimination from the group, since the Minnesota Test was usually not given after the age of $5\frac{1}{2}$ years. Many of the children who would otherwise have been included in Table V and a few who would have been included in Table IV are included in Table VI, in which the standing of the children on the initial Minnesota Test is compared with their standing on the 1916 Revision of the Stanford at the age of $5\frac{1}{2}$ years.

The same trend, however, is apparent in all three tables. The mean IQ on the initial test for the nursery-school group is essentially the same in all three of the smaller samples selected on the basis of the length of attendance as it is in the total group studied (see Table II). In the control group, not only have a larger number of cases been lost from the study but also those eliminated have tended, on the whole, to be the more backward members of the original group. This is shown by the higher *initial* mean IQ of the non-nursery-school cases included in Tables IV, V, and VI compared with that shown in Table II. These children, it will be remembered, have been followed for at least two years. The difference is not large but it is consistent.

Tables III to V may not give a complete picture of the effect of nursery-school attendance upon child IQ, since they are based only upon length of enrollment and take no account of varying regularity of attendance. As a check upon this possibility, we have computed the partial correlations between the Stanford-Binet IQ at the age of $5\frac{1}{2}$ years and number of days' *attendance* at nursery school *with initial*

IQ held constant. This treatment is to be preferred to the more common procedure of correlating length of attendance with gain or loss in IQ, because the latter is differentially affected by the unreliability of measurement and if, as is true for our cases, the children of superior ability have, on the average, the longer attendance records, the correlation between gain and length of attendance will be rendered invalid.

The correlation between length of attendance and Stanford-Binet IQ at 5½ years was +.137. With initial IQ rendered constant, this is reduced to +.013. The number of cases was 40; the range of attendance was from 42 to 530 days.

TABLE VI.—MEAN IQ ON THE INITIAL MINNESOTA TEST COMPARED WITH IQ ON THE STANFORD-BINET AT THE AGE OF FIVE AND A HALF

Occu- pational Group	Cases	Minnesota		Stanford-Binet	
		M	S.D.	M	S.D.
NURSERY SCHOOL					
I	16	108.8	13.7	119.7	12.6
II, III	7	107.5	17.1	117.5	13.9
IV, V, VI	17	109.6	14.7	114.6	11.0
Total	40	108.9	14.8	117.1	12.4
NON-NURSERY SCHOOL					
I	13	112.9	10.9	122.9	10.1
II, III	16	108.4	15.7	119.7	10.2
IV, V, VI	3	104.2		119.2	
Total	32	109.8	13.4	120.9	10.1

In none of these comparisons is there any indication whatever of an accelerating effect of nursery-school experience upon the intelligence of children as far as this can be judged by the results of standard intelligence tests. The data indicate that the nursery-school children constitute a selected group, superior, on the average, to the generality of children in the same occupational groupings; to a lesser extent, the same may be said of the children whose parents maintain contact with a research organization over a period of years. When retested, both groups show an effect of previous practice and at this stage approximately the same amount of this effect.

Table VII compares the two groups at the age of $6\frac{1}{2}$ years. The test used is the 1916 Revision of the Stanford. Forty nursery-school children and 41 non-nursery-school children are included. The differential effect of selection is again shown by the slightly higher initial mean of the non-nursery-school group that had survived to this age. It will be noted, too, that not only is the initial mean of this selected sample higher than that of the total non-nursery group from which it was drawn, but that also the *gain* in mean IQ from the time of the initial test is decidedly greater than that of the nursery-school children. Were this an isolated instance, we should be inclined to pay little attention to the matter, but a comparison of the test standing

TABLE VII.—MEAN IQ ON THE INITIAL MINNESOTA TEST COMPARED WITH IQ ON THE STANFORD-BINET AT THE AGE OF SIX AND A HALF

Occu- pational Group	Cases	Minnesota		Stanford-Binet	
		M	S.D.	M	S.D.
NURSERY SCHOOL					
I	14	110.4	9.2	120.4	13.2
II, III	16	111.3	11.1	113.8	11.3
IV, V, VI	10	112.5	16.8	111.0	14.4
Total	40	111.3	12.3	115.5	13.3
NON-NURSERY SCHOOL					
I	17	114.9	13.4	123.1	15.3
II, III	22	109.3	9.7	119.6	11.1
IV, V, VI	2	120.0		122.5	
Total	41	112.1	11.8	121.2	13.3

of nursery and control groups at $8\frac{1}{2}$, $10\frac{1}{2}$, and $12\frac{1}{2}$ years, in spite of changes in the sampling of subjects at each age, reveals the same trend: the differential gain tends to increase with age. Generally speaking, the differences are large enough to meet the usual criterion of 'statistical significance,' and the trend is apparent at all occupational levels.

The only reasonable explanation for this difference seems to be found in selection. Subject to later revision, our present hypothesis

is this: as children grow older, their intelligence quotients more closely approximate their ultimate mental status.¹ Theoretically, at least, intellectual status at maturity should correlate more highly with parental intelligence than is the case during childhood, since in childhood it is affected by whatever temporary fluctuations in growth rate may chance to occur, whereas at maturity it has become a stabilized function. If it is true, as our data appear to indicate, that the chance of a given child's being retained in the study is positively correlated with parental intelligence, and if it is also true that parent-child resemblance in mental traits increases with age up to the time of intellectual maturity, then it follows of necessity that the obtained intelligence quotients of groups thus selected will also tend to increase with age, owing to the inclusion of a greater proportion of cases whose IQ's are rising; that is, approaching more nearly to the level of their (superior) parents.

A comparison of nursery-school and control groups with respect to the two conditions mentioned indicates that selective elimination of cases from the study on the basis of parental intelligence is almost certainly present in the control group. Evidence for this conclusion will be presented elsewhere. In the nursery-school group, however, although selective influences appear in the original enrollment of children, the maintenance of contact with the Institute after the child has left school seems to be more dependent upon the personal relations established during the period of attendance than upon the intellectual superiority of the parents.

Obviously, the statistical question involved is an important one, since it has bearing on all extended longitudinal investigations in which a certain number of individuals are inevitably lost from any group with the passage of time. A more intensive study of the question is now under way in which the data from the older age-levels will be analyzed in considerable detail. Meantime it seems appropriate to point out the fact that even the use of groups of constant composition will not completely do away with the possibility of selective factors exercising an apparent, but fallacious, effect upon growth trends. Had the differences between our nursery-school and our control groups at the later ages been reversed in direction, it would have been easy to posit some kind of delayed effect of the early training as the basis

¹See J. E. Anderson, Part I, Chapter XIII, of this *Yearbook*.

for the change. In our opinion, the chief contribution of this study is to show the need for caution in assigning definite causative factors for results obtained when so many variables that may play a part in the situation must inevitably remain uncontrolled.

IV. DISCUSSION

None of the analyses that we have been able to make warrant the conclusion that attendance at the University of Minnesota Nursery School has any measurable effect whatever upon the mental development of children. Those who have had this training do no better on standardized intelligence tests than those who have not had it; they are neither more nor less advanced in school, and those who have attended longest and most regularly do not excel those whose period of enrollment was short and broken by frequent absences.

These findings are in essential agreement with those reported elsewhere in this Yearbook by Frandsen, Bird, Bayley, Voas, Olson, Lamson, and Anderson, as well as with certain other reports previously published,¹ but they diverge notably from the studies by Wellman in this volume and elsewhere, as well as from that by Starkweather and Roberts² and the previous investigations by Woolley and by Barrett and Koch.

Without more complete knowledge of the pertinent facts from the various studies mentioned than is now available, no satisfactory explanation of these discrepancies is possible.

In Part I, Chapter XII, of this Yearbook, some of the factors that at least theoretically may make for variant results in studies of this kind are discussed in some detail. Of these, the most important appear to be the following: (a) actual differences in the degree and kind of mental stimulation afforded by different schools, (b) selective factors that make for inequalities either in the original selection of experimental and control groups or in the cases eliminated from these groups in the course of long-time study, (c) differences in the tests or other measures of ability used, (d) differences in test administration, especially those resulting from unconscious bias on the part of the examiners, and (e) errors in computation of results or in statistical procedure.

The last four of these possibilities have already been considered in this chapter and need not be discussed here. Whether or not our nursery school affords less in the way of intellectual stimulation than

¹See summary of this material in Part I, Chapter XI.

²See Part II, Chapter XXII of this Yearbook.

others is a question that cannot be answered categorically. The following brief description may help the reader to judge for himself.

The Minnesota Nursery School admits children between the ages of two and four-and-one-half years; in exceptional cases, as early as 22 months. At any one time, the number of children enrolled has varied between 28 and 36. Children are promoted from the nursery school to kindergarten¹ at about the age of five or slightly earlier; none remain beyond the age of 5½ years.

The school employs three full-time teachers, all of whom hold college degrees and have had at least four years of special training in nursery-school methods. At all times at least two of the three have been teachers with several years' experience in nursery-school teaching.² In addition to the three regular teachers there is a principal, a nurse, and a physician (each of the two latter on part time), a cook, and a number of student assistants both at the graduate and the undergraduate level. The undergraduates are all seniors majoring in nursery-school teaching; the graduates are child-welfare majors holding research fellowships in the Institute. The child-teacher ratio varies at different hours of the day, since more assistants are used at the times when there is greatest need for supervision or when the emphasis is on teacher-directed activity rather than free play. In terms of average daily attendance it does not, as a rule, exceed six to one; in terms of actual enrollment it is never greater than nine to one.

The school day is from 9:00 A.M. until 3:45 P.M., making a total of 6¾ hours. The program is flexible, varying with temperature and weather conditions and with the immediate interests of the group. Roughly speaking, however, the 6¾ hours are divided in approximately the following manner:

- | | |
|--|-------|
| I. Activities connected with physical care and training in routine physical habits, such as morning inspection, taking off and putting on wraps, toilet, washing, dressing | 1 hr. |
| II. Eating, including both the noon lunch and the mid-morning and mid-afternoon lunches | ¾ hr. |
| III. Afternoon nap and supplementary rest periods | 2 hr. |

¹The Institute maintains an experimental kindergarten as well as a nursery school, but since the majority of the nursery-school children transfer to the public-school kindergartens, we have not considered kindergarten training (of any kind) in this study.

²As a rule, the third teacher is changed each year. This teacher is selected as being one of the most promising of the students completing the four-year training course in nursery-school and kindergarten methods offered by the University under the direction of the Institute. The previous experience of this teacher is in most cases limited to the three quarters of practice teaching that is required of all students majoring in this field.

- IV. Free play with minimum of teacher supervision. Emphasis here is on the gaining of social experiences, learning to get on with other children, encouragement of personal initiative, and the gaining of skills and knowledge through self-initiated experimentation with materials and toys 1½ hr.
- V. Music, teacher-directed but with child-participation ½ hr.
- VI. Stories and conversation as above ½ hr.
- VII. Teacher-directed activities with various materials, such as sand, clay, crayons, beads, scissors, and paper, and wood-working with simple tools ¾ hr.

During pleasant weather the children are sometimes taken on short excursions and the noon lunch is often converted into an outdoor picnic on the campus 'Knoll.' There are appropriate celebrations on holiday occasions and other changes of program from time to time as seems desirable.

In addition to the usual equipment, the nursery school makes a point of keeping a good supply of the so-called 'educational' toys and blocks, and a variable number of pets. A wading and swimming pool is used daily during warm weather.

In brief, the school aims to help in the formation of good physical, social, and emotional habits, to provide the children with opportunities for healthy activity, and to encourage participation in many kinds of group activities as preparation for social living. No attempt is made to stimulate intellectual development by urging the acquisition of special or unusual types of information or skills that are normally acquired at a later age, but the variety of experiences offered is unquestionably far greater than is likely to be had even in homes of superior culture. At all times the children are encouraged to experiment freely with the objects in their environment.¹ 'Learning through doing' is the keynote throughout the day.

On the surface, at least, this program does not seem essentially different from those of other full-day nursery schools. It seems evident, therefore, that if reports on the improvement in intelligence resulting from nursery-school training are valid, the source of such improvement must reside in more subtle factors that as yet have eluded our detection. This by no means implies that others may not have succeeded in producing results that we have failed to accomplish. The proof or disproof of claims must come from analyses of their data; it does not rest upon our findings or those of others who, like us, may merely be lacking in educational skill.

¹For a more detailed account of the school curriculum and of the educational philosophy on which it is based, see *Nursery School Education*, by J. C. Foster and M. L. Mattson, (D. Appleton-Century Co.: New York, 1939), 361 pp.

CHAPTER X

ADOPTED CHILDREN IN A PRIVATE SCHOOL

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How do adopted children in a selected private school population compare in mental ability with own children in the same population? The answer to this question may shed further light on the relative influences of heredity and environment in child development. Mental-test records available at the Lincoln School, Teachers College, Columbia University, furnish data relevant to the problem. The files contain 54 records of children reported to the school as having been adopted. Twenty-eight were boys, 26 girls. The date of adoption and child's age at adoption were available for 72 percent of the cases. For most of the cases there were adequate home and school records.

The test used in obtaining the IQ was the Stanford-Binet, except one examination each by means of the Otis, the Merrill-Palmer, the Minnesota Preschool, and the Kuhlmann-Binet. For 17 of the children two or more tests of intelligence were available.

The adopted group is similar in all respects to own children in the school population as concerns method of admission, age range, sex distribution, and socio-economic status of parents. The average home represented in the adopted cases is comparable to the average for the Lincoln School population. Both are of superior economic status. The majority of parents in both groups are professional persons, college educated, and highly intelligent.

The adopted children were placed in their foster homes mostly in infancy or early age, so far as our records indicate. About three-fourths of these children attended good private schools before entering Lincoln, and most of them attended a nursery school and kindergarten.

The distribution of the intelligence quotients for the adopted cases is shown in Table I. In case a child had been given more than one test, the several test scores were averaged and this average IQ was the one

included in the distribution. In Table I is also shown a cross-sectional distribution of the general Lincoln School population for the same age

TABLE I.—DISTRIBUTIONS OF INTELLIGENCE QUOTIENTS FOR
ADOPTED AND TWO CONTROL POPULATIONS

IQ Range	General Lincoln School Popu- lation, Cases	Terman's Binet Standard- ization Data, Percent of Cases	IQ Range	Adopted Children	
				Total Cases	Cases Under 2 Years of Age at Adoption
165 to 175	3				
155 to 165	2				
145 to 155	7				
135 to 145	31	0.55			
			130 to 135	1	1
125 to 135	69	2.3	125 to 130	2	2
			120 to 125	2	
115 to 125	94	9.0	115 to 120	4	1
			110 to 115	7	3
105 to 115	69	23.1	105 to 110	8	4
			100 to 105	9	5
95 to 105	33	33.9	95 to 100	8	4
			90 to 95	5	4
85 to 95	4	20.1	85 to 90	5	3
			80 to 85	2	..
75 to 85	..	8.6	75 to 80	..	..
65 to 75	..	2.3	70 to 75	..	..
			65 to 70	..	..
			60 to 65	1	1
55 to 65	..	0.33			
Total	312	100		54	28
Median	120.3	100.5		103.3	102

ranges as the adopted group, and the distribution of the standardization data for the Stanford-Binet as reported by Terman.¹ The IQ's

¹ L. M. Terman. *The Measurement of Intelligence*. (Houghton Mifflin: Boston. 1916) 362 pp.

for the 28 cases known to have been adopted under two years of age are given in the last column.

The results show that the adopted group (median IQ 103.3) is more similar to the general population (median IQ 100.5) than it is like the general Lincoln School population as a whole (median IQ 120.3). These results are shown graphically in Figure I. Obviously, the school

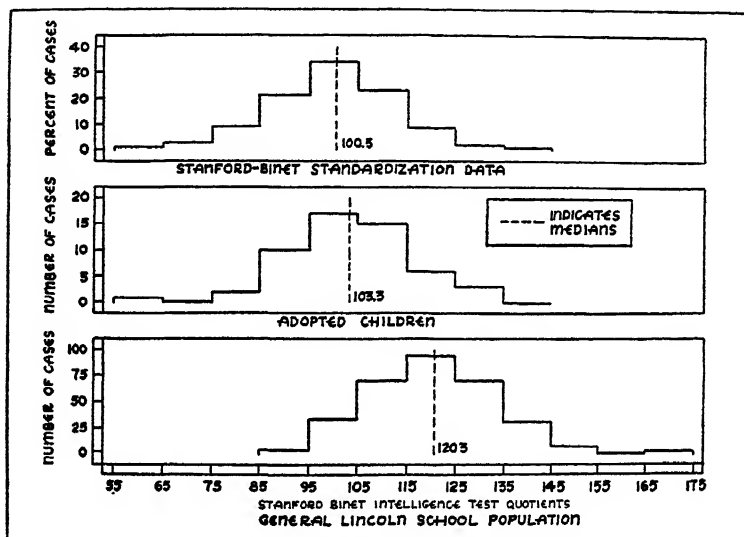


FIG. I.—COMPARISON OF THREE POPULATIONS IN INTELLIGENCE-TEST RATINGS

population as a whole tends to be mentally gifted; the adopted child group, average.

Most studies of adopted children indicate that as a group they tend to rate lower in intelligence than children in the general population. The fact that the adopted children in the Lincoln School population rate higher can be attributed possibly to two factors: first, they were a selected group among adoptees. The foster parents in most cases selected from all possibilities the most promising children, so far as this could be determined at an early age, and had the advice of experts on the question of adoption.² Second, the children's mental activity

²In one case the foster mother was actually the president of the Board of Trustees of the orphanage from which she obtained her adopted child.

had undoubtedly been maintained on a maximal level because of the superior influences in the homes in which they had been placed. These children may be testing higher than they would be if they had not been adopted into good families, though we have no direct proof of this fact. Foster parents have in some cases sought out this superior school with the intention of offsetting the relatively slow development the adopted child was exhibiting in adjustment and learning.

There is nothing in our data to support the contention that living in these superior homes and attending a good school raises the intelligence level of the adopted cases for the group as a whole to that of own

<i>Change in IQ; Last Test Compared with First Test</i>			
<i>IQ Gain</i>	<i>Frequency</i>	<i>IQ Loss</i>	<i>Frequency</i>
17	1	— 1	1
16	..	— 2	1
15	..	— 3	1
14	..	— 4	..
13	..	— 5	1
12	..	— 6	..
11	1	— 7	..
10	..	— 8	2
9	..	— 9	1
8	..	—10	..
7	..	—11	1
6	..	—12	1
5	1	—13	..
4	..	—14	..
3	1	—15	..
2	..	—16	..
1	..	—17	1
0	2		
Total Cases			16
Median Change			—2

children in the same school population. The accompanying tabulation shows a distribution of the gains and losses in IQ when last tests are compared with first ones for those who had two or more tests, regardless of time interval between tests. The median change was a loss

in IQ of 2 points. For the Lincoln School population as a whole (1,100 pairs of tests), the median change was found to be a gain of 4.5 points of IQ.¹

Table II shows in a scatter diagram the relation between IQ and years in the foster home. The correlation approximates zero.

These adopted children have remained in school for a comparatively short period because they are frequently unable to compete scholastically with the brighter children. As a group they do not make as satisfactory academic progress or personality adjustments as own children, though certain individuals among the adopted children get along fully as well as the own children in the school.

We have studied the mental development of one pair of adopted twins in the dull-normal category, for several years. Their test ratings

TABLE II.—IQ AND NUMBER OF YEARS IN FOSTER HOME
FOR THIRTY-EIGHT CASES

IQ	Years in Foster Home													
	0-1	1	2	3	4	5	6	7	8	9	10	11	12	13
130					1									
125						1								
120									1					
115			1	1		1		1	1					
110	1				1			1					1	
105		1	2					1				2		
100					1	1	1	2				1		1
95						1		1	1			1		
90			1									1		
85											1			1
80	1									1				
75										1				
70										1				
60			1											

have stayed fairly constant, despite the fact that they have remained in their superior home and have the advantages of the best possible educational facilities.

¹ G. Hildreth. "Stanford-Binet retests of 441 school children." *Ped. Sem. and Jour. Genet. Psychol.*, 33: 1926, 365-386.

The foster parents have done everything humanly possible to compensate for the children's apparent slowness in mental development. It is interesting to note that the unusual care exercised by the other parents in choosing children for adoption was not exercised by these foster parents. The story is that the foster parents of these twins one day met a laborer on the road taking his babies to an orphanage, were emotionally stirred by the father's plight and immediately decided to adopt the children, provided the proper arrangements could be made. Shortly after, the twins went to live in their new home. The test results from these children showed no appreciable tendency to rise after nearly 8 years in a superior home and equally superior school.

From the results of this study we may conclude that adopted children in a gifted school population tend to rate on intelligence tests more like the general countrywide population in mental ability than like the general population in the selected school population. So far as our records go, there is little evidence that attendance at such a school raises the average ability of these adopted children much above the general population level, or that continued attendance in the school is accompanied by an increase in intelligence as measured by individual tests.

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CHAPTER XI

AGE CHANGES IN THE RELATIONSHIP BETWEEN CERTAIN ENVIRONMENTAL VARIABLES AND CHILDREN'S INTELLIGENCE¹

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I. INTRODUCTION

In a recent review of the literature on socio-economic status and intelligence, Neff (8) writes (p. 748) that "we must regard the question of the precise character of the relationship between age, intelligence, and socio-economic status as unsettled at present." The paucity and indecisive nature of investigations of the problem, together with a consideration of the changing character of test items at various ages, led Neff to this conclusion. He adds that Bayley's study (1) showing an increasing relationship between mid-parent education and children's mental scores, for a group tested during infancy and early childhood, deserves very careful follow-up. More recently Bayley and Jones (2) have reported correlations between a number of socio-economic variables and the mental-test scores for this same group of 61 children tested seriatim between the ages of one month and six years. The correlations are predominantly zero or slightly negative to 18 months of age but increase thereafter to coefficients ranging from .29 for a social rating to .59 for mid-parent education at 6 years.

The present report deals with the emergence of a relationship between certain socio-economic variables and intelligence for a larger group that is representative of the children living in an urban community. As compared with previous studies using similar methods, the value of this investigation may lie in the size and representative-

¹Assistance in the preparation of these materials was furnished by the personnel of Works Progress Administration Official Project No. 465-03-3-631.

ness of the sample; its main limitation, in the fact that the testing program did not begin until the children were 21 months old.

II. THE SAMPLE

Two hundred and fifty-two children, who constitute a representative sampling of all born in Berkeley, California, in the period January, 1928, to June, 1929, were brought to the Institute for their first mental test at the age of 21 months.¹ At this time the group was divided into two matched samples of 126 children each on the basis of certain socio-economic factors (race and nationality of the parents, income level, father's occupation, social rating, size of family, mother's age and education). One of these samples has been followed intensively by the Child Guidance Research Study, under the direction of Dr. Jean Walker Macfarlane (7), and will be referred to as the 'guidance group.' The second sample will be referred to as the 'control group.' The children in both groups were given mental tests at the following ages:

<i>Guidance Group</i>	<i>Control Group</i>	<i>Guidance Group</i>	<i>Control Group</i>
21 months	21 months	4 years	4 years
2 years		5 years	5 years
2½ years		6 years	6 years
3 years	3 years	7 years	7 years
3½ years	3½ years	8 years	8 years

Every effort was made to test the children on their birthdays, and from 72 to 95 percent of the children were tested within one month of that date at the various age levels. From 98 to 117 of the 126 children in each group were examined at the specified age levels. Temporary or permanent removal of the family from Berkeley was the most common cause of a missed test.

Distributions of the education of the parents and the occupations of the fathers are shown in Tables I and II. It will be seen that these

¹The monograph by Macfarlane (7) describes the sample in detail and the methods used by the Institute staff to secure maximal coöperation from the parents.

parents, although constituting a fairly representative Berkeley sample, are for the most part well educated. The fact that the University of California is situated in Berkeley probably accounts in part, at least, for the educational level of these parents. There is a larger proportion of professional and 'white-collar' workers in the two groups than is

TABLE I.—EDUCATION OF THE PARENTS OF CHILDREN IN
THE GUIDANCE AND CONTROL GROUPS

<i>Education</i>	<i>Fathers</i>				<i>Mothers</i>			
	<i>Guidance Group</i>		<i>Control Group</i>		<i>Guidance Group</i>		<i>Control Group</i>	
	<i>Num- ber</i>	<i>Per- cent</i>	<i>Num- ber</i>	<i>Per- cent</i>	<i>Num- ber</i>	<i>Per- cent</i>	<i>Num- ber</i>	<i>Per- cent</i>
College	51	41	49	39.5	41	33	40	32
High School	41	33	47	38	54	43	59	48
Grammar School	33	26	28	22.5	30	24	25	20
Total	125	100	124	100	125	100	124	100

true for the United States at large; however, the per capita income is below the national average (7).

III. THE DATA

1. Mental Tests

The mental tests used were the California Preschool Schedules I and II¹ between the ages of 21 months and 5 years; the Stanford-Binet at 6 and 7 years; and the new revision of the Stanford, Form L, at 8 years.

Neff's criticism that tests of early intelligence may not be measuring the same abilities as those measured by later tests of intelligence applies to this

¹Copies of these tests are printed in the monograph by Macfarlane describing the methodology of data collection and organization in the guidance study (7). The published California Preschool Mental Scale Form A (5) is composed largely of items from the California Preschool Schedule I, together with a few items from the California Preschool Schedule II. The test items for the California Schedules I and II include selections made by Dr. Adele S. Jaffa from several standardized tests, together with some original items first validated at the Institute. These scales have been 'normed' by the Thurstone method of absolute scaling.

study as it does to previous ones. It seems likely that this criticism can never be adequately met, because children characteristically exhibit dramatic changes in behavior between birth and maturity and the nature of the test items must of necessity show some corresponding changes. Even on those tests where an effort has been made to include similar types of test items at successive ages, the items vary markedly for disparate age levels. All we can expect of a test is that no abrupt changes occur in the kinds of test items included, and that only items that emphasize mental rather than motor abilities be used in infant and preschool tests. Inspection of the two Cali-

TABLE II.—FATHERS' OCCUPATION AT BIRTH OF CHILD

<i>Occupation</i>	<i>Guidance Group</i>		<i>Control Group</i>	
	<i>Num- ber</i>	<i>Per- cent</i>	<i>Num- ber</i>	<i>Per- cent</i>
Professional and				
Executive	31	25	33	27
'White Collar'	49	39	50	40
Students	3	2	3	2
Skilled Labor	26	21	23	19
Semiskilled Labor	14	11	12	10
Unskilled Labor	2	2	3	2
Total	125	100	124	100

fornia Preschool Schedules shows that a great effort has been made to test similar abilities at every age level (4-7), and the high correlations between scores earned at adjacent age levels on these tests further attest the absence of abrupt changes in the kinds of items included. The further fact that test items at the upper levels of the preschool tests are similar to those of the six- and seven-year levels of the Stanford-Binet is suggested by the finding that the correlations between scores earned on the Preschool Schedules and the Stanford are as high as the correlations between scores earned at adjacent ages on the preschool tests.

The raw, or total-point, scores on the preschool tests were converted into sigma values, so that comparable scores were available for each child at all age levels. The IQ's obtained on the Stanford-Binet and Stanford Revision, Form L, were also converted into sigma scores. In every instance the means and standard deviations of the

scores of the combined guidance and control groups were the norms used in computing the sigma scores.

The tests were given by experienced examiners, principally Miss Lucile Allen and Mr. G. V. Sheviakov.

The average IQ's of the children in the two groups at ages 6, 7, and 8 years are shown in Table III. The children in the guidance group had had 7 tests, and the children in the control group 5

TABLE III.—IQ'S OF THE CHILDREN IN THE GUIDANCE AND CONTROL GROUPS AT AGES 6, 7, AND 8 YEARS

<i>Age in Years</i>	<i>Test</i>	<i>Guidance Group</i>			<i>Control Group</i>		
		<i>N</i>	<i>Mean</i>	<i>S.D.</i>	<i>N</i>	<i>Mean</i>	<i>S.D.</i>
6	Stanford-Binet	109	118.8	11.6	102	118.3	13.5
7	Stanford-Binet	104	119.6	14.3	104	117.0	11.8
8	Stanford Revision, Form L	100	119.4	17.4	98	118.4	16.3

tests, previous to the one given at 6 years. The average IQ's of 119 and 118 for the two groups at this age indicate the level of intelligence in this urban community; repeated testing has also had some effect on increasing scores, although only a slight rise in the average IQ is observable between the 6- and 8-year tests. The variability, as measured by the standard deviations of the IQ's, is below that usually found in unselected samples at ages 6 and 7 years but is definitely higher on the Stanford Revision, Form L, at 8 years. This restricted variability on the 6-year and 7-year tests will, of course, have the effect of lowering the correlation between these scores and other variables.

2. Environmental Data

A social investigator, Miss Frances Welch, visited the child's home soon after his birth and secured certain information on the child's environment, which was used in assigning a socio-economic rating or index to the home.¹ This socio-economic index, the mother's and father's education, and the combined mid-parent education have been

¹ This socio-economic rating is based upon four items: (a) social scale (average of ratings of house exterior, neighborhood, living room, family accommodations, and special equipment); (b) education of the parents; (c) father's occupation (Taussig Scale); and (d) family income. These items contribute 36, 17, 20, and 26 percent, respectively, to the total rating (9).

considered in relation to the children's mental-test scores at the different age levels. One further measure was also used, the average of a number of independent ratings of the mother's intelligence, computed as indicated below:

TABLE IV.—CORRELATIONS OF CERTAIN SOCIO-ECONOMIC MEASURES WITH THE CHILDREN'S MENTAL-TEST SCORES AT SUCCESSIVE AGES

Age	Parents' Education				Socio-Economic Index	
	Num- ber	r			Num- ber	r
21 months	234	.06	.07	.07 \pm .04	231	.04 \pm .04
2 years	113	.07	-.05	.00 \pm .06	112	-.01 \pm .06
2½ years	114	.10	.03	.07 \pm .06	113	.02 \pm .06
3 years	229	.09	.11	.12 \pm .04	227	.15 \pm .04
3½ years	215	.26	.21	.25 \pm .04	214	.24 \pm .04
4 years	211	.23	.24	.26 \pm .04	210	.28 \pm .04
5 years	210	.35	.29	.34 \pm .04	209	.38 \pm .04
6 years	211	.32	.30	.33 \pm .04	213	.35 \pm .04
7 years	208	.33	.40	.40 \pm .04	207	.42 \pm .04
8 years	198	.33	.35	.36 \pm .04	197	.41 \pm .04

Guidance Group: The psychologist and psychiatric social worker interviewing the mothers of children in the guidance group made independent ratings of the mother's intelligence on a 7-point scale. The agreement between these two judges' ratings is fairly high ($r = +.68$), considering the broad categories of the scale. The ratings made by the two judges for each mother were averaged and this average rating is the one used in relation to the children's mental-test scores.

Control Group: Ratings of the intelligence of mothers of children in the control group were made by the psychologist who gave mental tests to the children. After each test, the psychologist had a short interview with the mother concerning the child's habits and behavior at home. A rating of the mother's intelligence on a 7-point scale was made on the basis of this interview. Since this procedure leads to the possibility of some slight halo effect from a knowledge of the child's mental performance, the results to be reported will deal with the guidance and control groups separately.

IV. RESULTS

1. Group Trends

The correlations between cultural-economic variables and the children's mental-test scores are shown in Tables IV and V. The most

striking fact of these tables is that for all the environmental variables, the correlations are negligible on the first test at 21 months (r 's range from .06 to .26); but by 3½ years statistically significant relations are shown between the children's mental-test scores and the parents' education ($r = .25 \pm .04$), ratings of the mother's intelligence ($r = .39 \pm .06$ and $.50 \pm .05$), and the socio-economic index ($r = .24 \pm .04$). Table VI presents a comparison of the relationship between parents' education and the children's mental-test scores in two comparable samples, the guidance and control groups. The similarity in results suggests that these are not chance findings and that they would probably be duplicated under similar conditions of sampling and testing.¹

TABLE V.—CORRELATIONS OF RATINGS OF MOTHER'S INTELLIGENCE WITH THE CHILDREN'S MENTAL-TEST SCORES AT SUCCESSIVE AGES

Age	Guidance Group		Control Group	
	<i>N</i>	<i>r</i>	<i>N</i>	<i>r</i>
21 months	116	.11 \pm .06	99	.26 \pm .06
2 years	112	.08 \pm .06		
2½ years	113	.06 \pm .06		
3 years	115	.17 \pm .06	100	.50 \pm .05
3½ years	107	.39 \pm .06	101	.50 \pm .05
4 years	105	.38 \pm .06	100	.60 \pm .04
5 years	103	.53 \pm .05	101	.64 \pm .04
6 years	108	.40 \pm .05	102	.64 \pm .04
7 years	103	.51 \pm .05	100	.60 \pm .04
8 years	99	.54 \pm .05	94	.55 \pm .05

An attempt must be made to reconcile these results with those of other investigators. Goodenough (3) reported correlations between mid-parent education and the children's intelligence-test scores for samples ranging from 31

¹Although the group differences are negligible for the most part, there are a number of exceptions, the most notable of which occur at five years. The correlation between the mother's education and the children's mental-test scores is .45 for the guidance group, but .25 for the control group at this level. Similarly, the correlation between the father's education and the children's mental-test scores is .40 for the guidance group, but only .19 for the control group. These discrepancies suggest the influence of chance factors on the coefficients, even though the number of cases in both groups approximates 100 at every age level.

to 47 cases. Her correlations between mid-parent education and the mental-test scores of 2-, 3-, and 4-year-old boys are .15, .49, and .18, respectively; and her coefficients for the girls at these ages are .44, .48, and .21. Thus, although the correlations are higher for the tests of the 3-year-olds than those of the 2-year-olds, there is no increase in relationship between the 3- and 4-year tests. The small number of cases in each group could easily account for this finding of a lack of consistent increase in relationship with age. Higher coefficients were obtained on a second test given 6 weeks after the first, suggesting that the relationships were lowered by emotional factors present on the first test.

TABLE VI.—CORRELATIONS OF THE PARENTS' EDUCATION WITH THE CHILDREN'S MENTAL-TEST SCORES FOR THE GUIDANCE GROUP AND THE CONTROL GROUP COMPARED

Age	Number of Cases		Education of the Parents			
			Mother		Father	
			r^*		r^*	
	Guid- ance	Con- trol	Guid- ance	Con- trol	Guid- ance	Con- trol
21 months	117	117	.13	.00	.10	.05
3 years	116	113	.10	.08	.01	.19
3½ years	107	108	.27	.25	.17	.25
4 years	105	106	.22	.25	.17	.30
5 years	104	106	.45	.25	.40	.19
6 years	109	102	.27	.37	.24	.36
7 years	104	104	.35	.33	.37	.43
8 years	100	98	.34	.32	.37	.34

*The probable errors of these r 's range from .05 to .07.

In the longitudinal investigation reported by Bayley and Jones (2), the correlations between a number of socio-economic variables and the children's mental-test scores at 18 months were negligible, but by 2 years the correlations were all positive, ranging from .20 (family income) to .52 (mother's education). The fact that lower coefficients were obtained in the guidance and control groups at the 2-year level than in the group tested by Goodenough or Bayley may therefore be the result of one or both of the following factors: (a) emotional factors on the first tests may have obscured the relationships existing in the guidance and control groups; and (b) the presence of a few extreme cases may have had a marked effect in increasing the correlations in the Goodenough and Bayley-Jones investigations.

An interesting point is the relatively abrupt increase in the relation of the environmental variables to the child's mental-test scores between the 3-year and 3½-year tests. The correlation between mid-parent education and the children's scores increased from $.12 \pm .04$ at 3 years to $.25 \pm .04$ at 3½ years; and the increase in the index of relation is noticeable in both groups and for both the mother's and father's education. This rather abrupt increase in correlation appears in the Bayley-Jones investigation between 18 and 21 months; their coefficients increased from $.16$ to $.29$. A further point of interest is that the relationship was increasing in the Bayley-Jones group up to 6 years when the report was published, and is increasing in the present study up to 7 years, although the correlations in the guidance and control groups are all lower than those reported by Bayley and Jones (2).

The socio-economic index gives slightly higher correlations with the children's scores than does the mid-parent education. The correlations range from $.04 \pm .04$ at 21 months to $.42 \pm .04$ at 7 years.

As has been mentioned, the socio-economic index is based in part on the father's occupation (Taussig Scale). In Table VII are shown the range and the average IQ's of the children of fathers of different occupational levels. At six years the average IQ of children whose fathers' occupations are classified as 'professional or executive' is 123 for the 30 children in the Guidance Group, and 124 for the 27 children in the Control Group. By the age of 8 years, the IQ's of these same children of professionals or executives are 126 and 128, respectively. Thus, these children have shown an average gain (3.5 points of IQ) greater than the mean gain for the groups as a whole (.3 points of IQ; see Table III). At the other end of the scale, the average IQ's of the children of unskilled laborers are 113 for the Guidance and 104 for the Control Group at 6 years. By the age of 8 years, the average IQ's of these children have dropped to 104 and 93, respectively. Thus there is not only a decided difference in the IQ's of children of fathers in the different occupations, but this differentiation also continues between the ages of 6 and 8 years.

The rating of the mother's intelligence is more highly correlated with the children's mental-test scores than either the parents' education or the socio-economic index (Table V). The correlation is $.17 \pm .04$ at 21 months and is highest at the 5-year level ($r = .55 \pm .03$).

Although the child's mental-test performance may have affected the examiner's rating of the mother's intelligence in the control group, this was not so likely to happen in the guidance group, where one rating was made by a psychologist who gave no tests, and who was on the whole less interested in the child's mental-test performance than in other characteristics.

TABLE VII.—THE IQ'S OF THE CHILDREN IN RELATION TO
THEIR FATHERS' OCCUPATIONS

<i>Father's Occupation</i>	<i>Guidance Group</i>			<i>Control Group</i>		
	<i>N</i>	<i>Mean IQ</i>	<i>IQ Range</i>	<i>N</i>	<i>Mean IQ</i>	<i>IQ Range</i>
<i>6 Years</i>						
Profess'n'l and Exec.	30	123	99 to 157	27	124	94 to 170
'White Collar'	46	120	94 to 146	46	118	94 to 139
Students	1	120		3	133	131 to 136
Skilled Labor	18	112	96 to 141	17	113	98 to 128
Semiskilled Labor	12	113	87 to 128	9	110	97 to 123
Unskilled Labor	2	113	108 to 117	3	104	97 to 111
<i>7 Years</i>						
Profess'n'l and Exec.	27	125	105 to 151	25	123	102 to 142
'White Collar'	45	123	97 to 149	48	116	89 to 140
Students	1	128		3	132	131 to 134
Skilled Labor	17	109	87 to 150	17	112	98 to 131
Semiskilled Labor	13	107	81 to 131	8	109	83 to 119
Unskilled Labor	1	105		3	104	101 to 109
<i>8 Years</i>						
Profess'n'l and Exec.	25	126	103 to 158	24	128	104 to 167
'White Collar'	42	124	85 to 160	44	117	90 to 158
Students	1	117		3	142	138 to 144
Skilled Labor	17	107	86 to 140	16	112	93 to 129
Semiskilled Labor	13	106	85 to 133	8	106	93 to 122
Unskilled Labor	2	104	91 to 117	3	93	82 to 100

The results of the present study and of previous ones agree in showing that:

1. The relation of the socio-economic index, parents' education, and mother's intelligence to the children's intelligence-test scores becomes statistically significant during the early preschool period, between 1½ and 3½ years; and these relationships increase into the school period.

2. Emotional factors present on initial tests may tend to obscure these relationships.

3. A comparison of the findings of different investigators suggests that there are wide individual differences in the ages at which the mental-test scores of individual children begin to approach that which is representative of the child's family and home.

2. Mid-parent Education in Relation to Changes in Mental-Test Scores

In addition to the successive cross-sectional correlations, the relation between mid-parent education and mental-test increments (or changes in the children's mental-test scores from one test to another) was computed as follows:

<i>Changes in Mental-Test Sigma Scores between Ages</i>	<i>Correlation of Mid-parent Education with Changes in Mental-Test Scores</i>
21 months and 3 years	.04
21 months and 4 years	.29
21 months and 5 years	.22
21 months and 6 years	.25
21 months and 7 years	.27 \pm .04
21 months and 8 years	.28 \pm .04
3 years and 4 years	.19 \pm .05
4 years and 5 years	.07
5 years and 6 years	.05

Each of these coefficients represents the correlation between (a) an average of the number of years of schooling of both parents, and (b) mental-test increments, or changes in the mental-test sigma scores from one examination to another. The mental-test increments range from negative to positive values, with an average of zero.

As was to be expected from the correlations at the various age levels, mid-parent education is positively related to above-average gains in mental-test scores. This relation tends to increase with the interval between tests. The correlation for the 15-month period (21 months to 3 years) is .04; that for the 6 $\frac{1}{4}$ -year period (21 months to 8 years), .28 \pm .04. However, these correlations tend to decrease with increasing age if the interval between tests is kept constant. Thus the correlation between mid-parent education and the children's mental-test scores for the year-period 5 to 6 years is .05; for the year-period

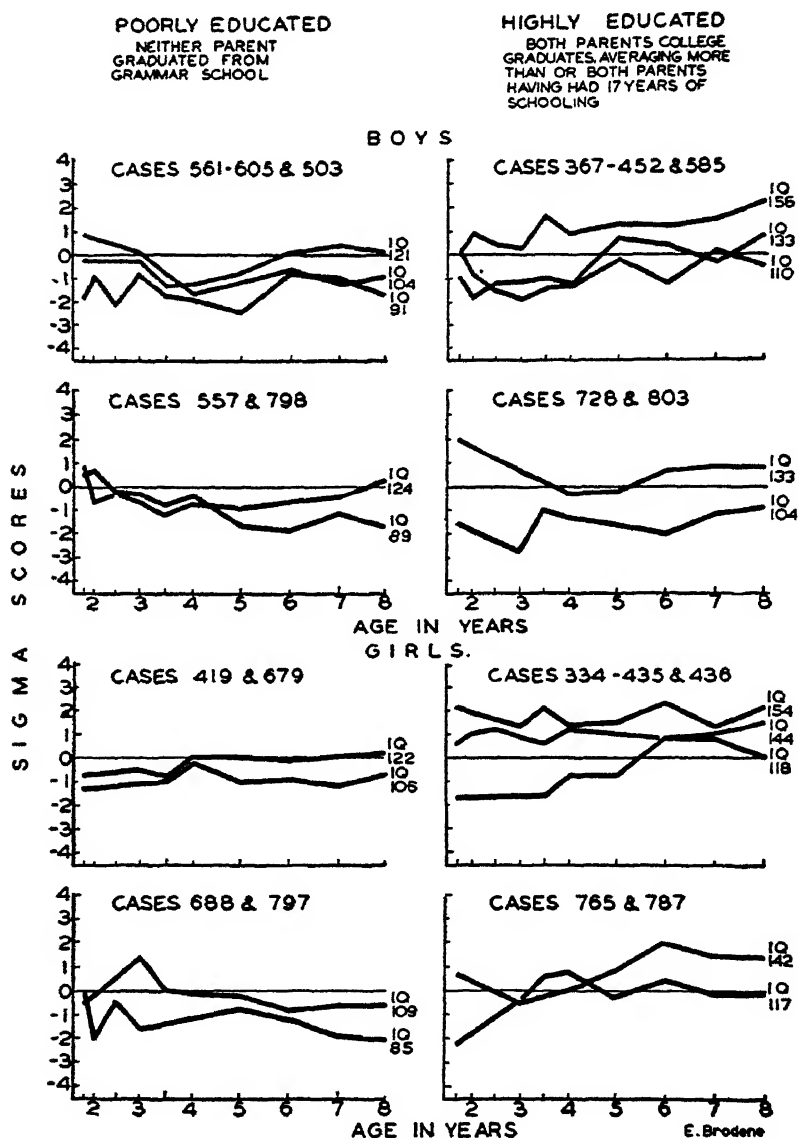


FIG. I.—INDIVIDUAL MENTAL-TEST CURVES OF CHILDREN
WHOSE PARENTS ARE POORLY EDUCATED
AND HIGHLY EDUCATED

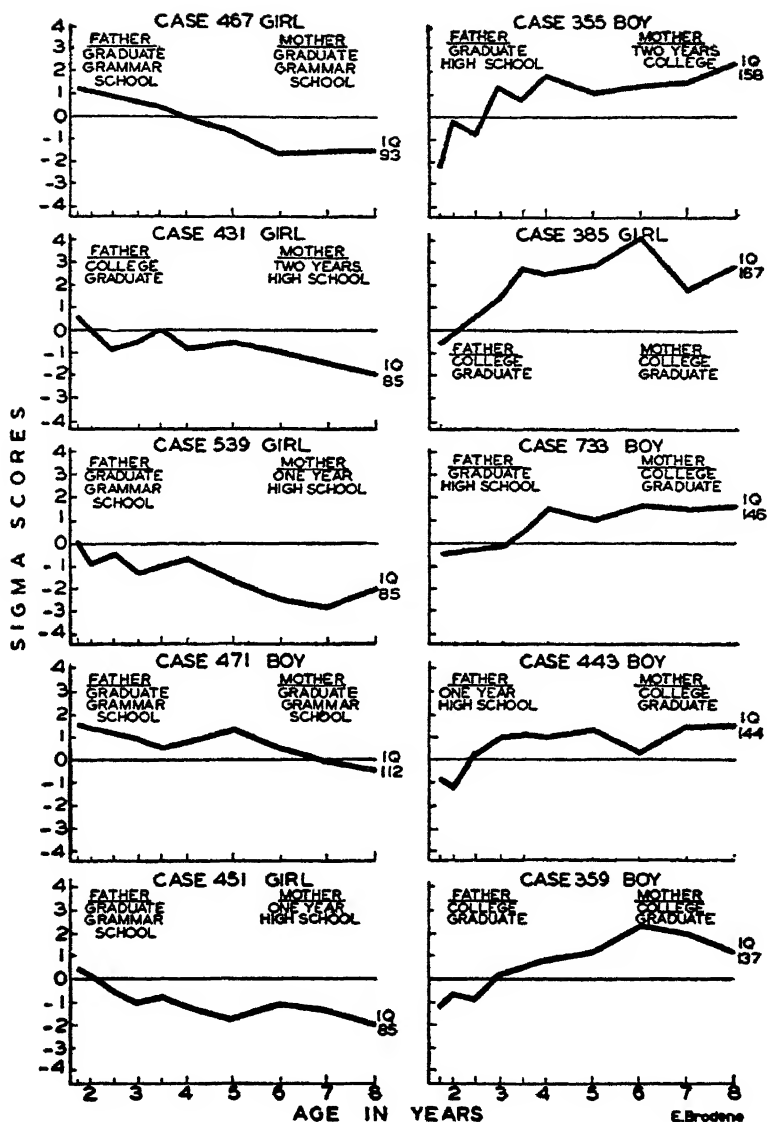


FIG. II.—THE EDUCATION OF THE PARENTS OF INDIVIDUAL CHILDREN WHO SHOWED MARKED CHANGES IN MENTAL-TEST SCORES BETWEEN 21 MONTHS AND 8 YEARS

4 to 5 years, $.07$; but between 3 and 4 years, $.19 \pm .05$. These results, then, confirm the conclusion drawn from the cross-sectional coefficients that the most marked increase in relationship occurs in the early pre-school years.

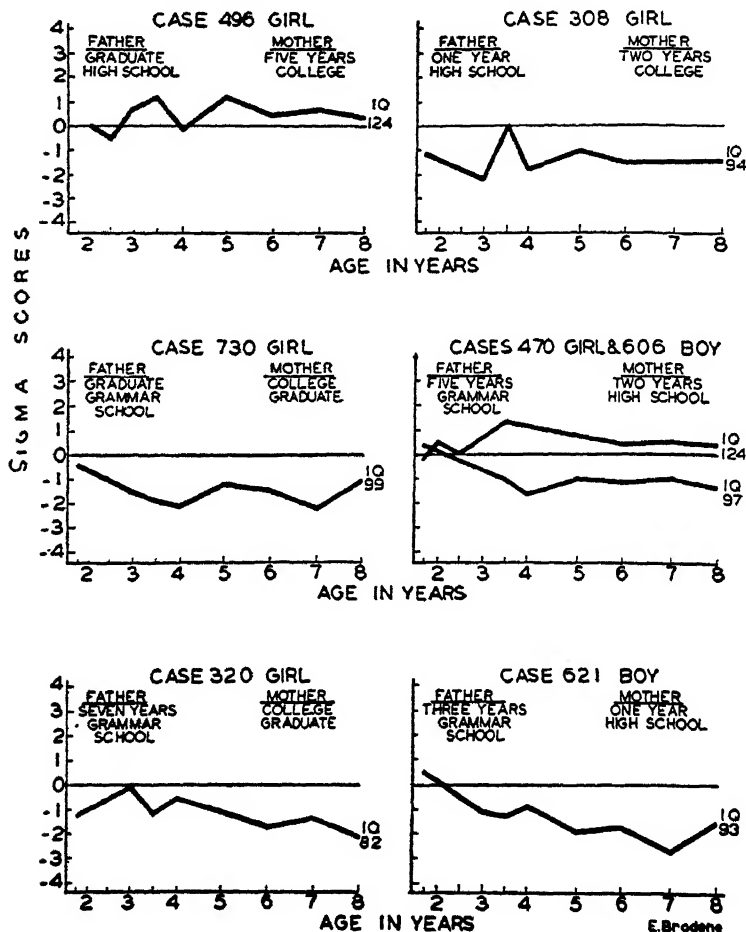


FIG. III.—INDIVIDUAL MENTAL-TEST CURVES OF CHILDREN WHOSE MOTHERS HAD MORE EDUCATION THAN THEIR FATHERS

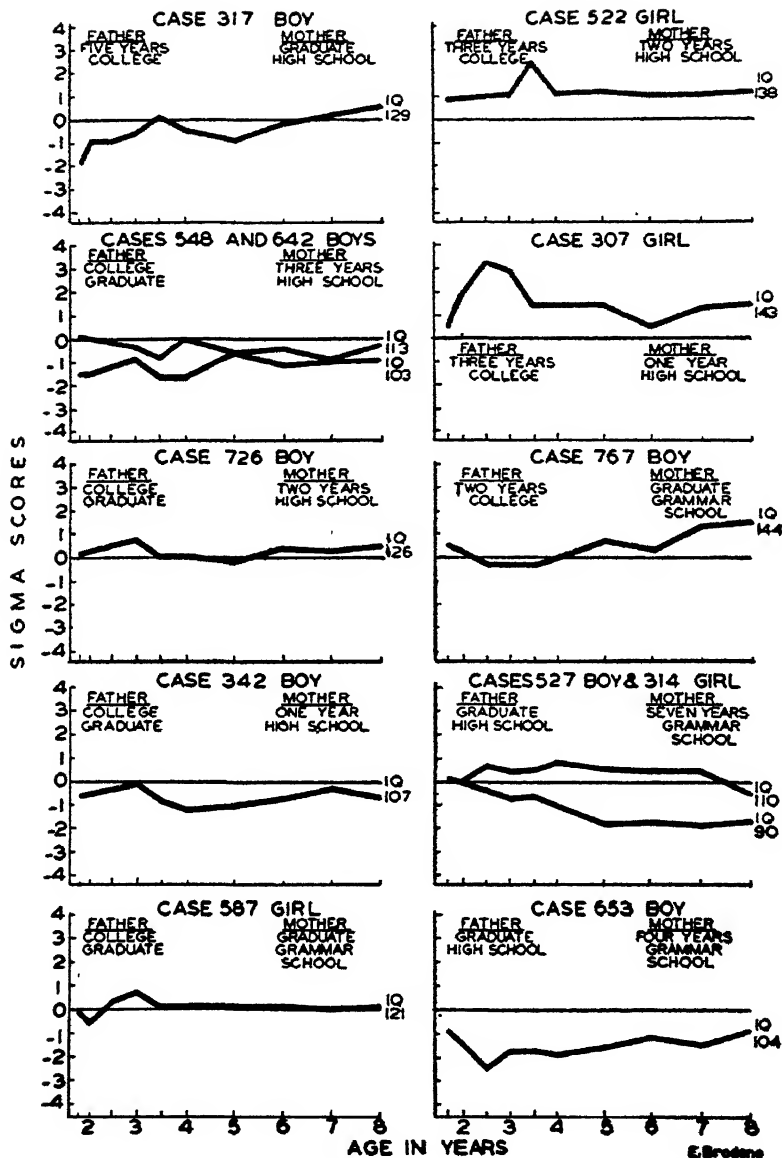


FIG. IV.—INDIVIDUAL MENTAL-TEST CURVES OF CHILDREN
WHOSE FATHERS HAD MORE EDUCATION THAN
THEIR MOTHERS

3. Environmental Factors in Individual Cases

More interesting, perhaps, than the group results are the relationships found in individual families. The mental-test curves of individual children shown in Figures I, II, III, and IV are in terms of sigma or standard scores. If a child maintains his position in relation to the rest of the group, the record takes the form of a horizontal straight line. Curves with upward and downward slopes indicate above-average or below-average gains in mental-test performance.

a. Children of Highly versus Children of Poorly Educated Parents. In Figure I the mental-test curves of children of highly educated parents are compared with those of children whose parents had very little education. There were 10 children whose parents either averaged more than 17 years of schooling, or each of whose parents had 17 years of schooling. Only 5 of the children of these highly educated parents made above average scores at 21 months, but on the 8-year test, 8 of the 10 earned scores that were average for the group or better. Inspection of the curves in Figure I shows that the scores of the girls tend to stabilize before those of the boys—a fact that may be related to maturation differences.

There were 5 boys and 4 girls, neither of whose parents graduated from grammar school. These children earned average or below-average scores at every age level. There is a trend in the direction of a decline in score that is more evident for the boys than the girls. Greater fluctuations appear to occur in the mental-test scores of children of highly educated, than of children of poorly educated parents.

The IQ's of the children of poorly educated parents range from 85 to 124 at 8 years, while those of the children of highly educated parents range from 110 to 156. The average IQ of all the children at this age is 119.

b. Children Showing the Most Marked Changes in Score between Twenty-One Months and Eight Years. The mental-test curves of the 5 children showing the greatest decline in test score during the age period 21 months to 8 years are shown in Figure II. The education of the parents of these children is described on the curves. In the same figure, for comparative purposes, are shown the mental-test curves of the 5 children showing the most marked gains in score between 21 months and 8 years. The education of the parents of these 10 children are summarized in the tabulation that follows.

All the parents of children making the most significant gains in mental-test performance had a high-school or college education; whereas 60 percent of the parents of children whose scores declined most markedly during the period 21 months to 8 years had only a grammar-school education. Thus there is a marked tendency for the most significant gains to occur in highly educated families and the most significant losses, in families where the parents are not well educated.

Parents' Education	Education of Parents of Children Whose Gains in Mental-Test Scores Were:	
	Above Average	Below Average
College	7	1
High School	3	3
Grammar School	0	6

c. *Dissimilar Education in the Parents and Its Relation to the Mental-Test Scores of the Children.* The coefficient of correlation between the number of years of schooling of the mothers and fathers of the children in the guidance group is $.74 \pm .03$, and in the control group $.71 \pm .03$. In spite of this tendency toward assortative mating with respect to education, there were 19 families in which there was a difference of 5 or more years in the number of years of schooling had by the two parents. In 12 families the father, and in 7 families the mother, was the more educated parent. The mental-test curves of the children whose mothers had at least 5 more years of schooling than the fathers are shown in Figure III, the data of which may be summarized as follows:

Case	Education		Child's Mental- Test Record
	Mother	Father	
496	5 yrs. college	4 yrs. high school	Average*
730	4 yrs. college	8 yrs. grammar school	Below average
320	4 yrs. college	7 yrs. grammar school	Below average
308	2 yrs. college	1 yr. high school	Average
470	2 yrs. high school	5 yrs. grammar school	Average
606	2 yrs. high school	5 yrs. grammar school	Below average
621	1 yr. high school	3 yrs. grammar school	Below average

*As elsewhere in this chapter, 'average' refers to the mean of the group, which is somewhat higher than 100 IQ.

The mental-test curves of children whose fathers are more educated than their mothers are shown in Figure IV. These results are summarized in the following tabulation:

<i>Case</i>	<i>Father</i>	<i>Education</i>	<i>Mother</i>	<i>Child's Mental-Test Record</i>
317	5 yrs. college	4 yrs. high school		Slightly above average
548	4 yrs. college	3 yrs. high school		Below average
642	4 yrs. college	3 yrs. high school		Average
726	4 yrs. college	2 yrs. high school		Slightly above average
342	4 yrs. college	1 yr. high school		Slightly below average
587	4 yrs. college	8 yrs. grammar school		Average
522	3 yrs. college	2 yrs. high school		Above average
307	3 yrs. college	1 yr. high school		Above average
767	2 yrs. college	8 yrs. grammar school		Above average
527	4 yrs. high school	7 yrs. grammar school		Below average
314	4 yrs. high school	7 yrs. grammar school		Average
653	4 yrs. high school	4 yrs. grammar school		Below average

In a study of the issue of unlike parents, using intelligence-test scores for both parents and children, Jones (6) found a tendency for the children to be intermediate in intelligence rather than to resemble the more intelligent parent. Similar results may be noted in the present study, where the parents are classified on the basis of education, rather than directly on the basis of intelligence. Emphasis upon the environmental nature of parental influence perhaps leads to the prediction that children would tend to resemble the superior of two parents; so far as these two studies are concerned, the evidence is more consonant with theories as to hereditary factors in mental development, although it does not support any simple formulation as to the genetic dominance of superior intelligence.

One further fact is brought out by the records of individual children. For certain cases the mental-test curves show consistent above-average or below-average gains in scores; for the most part these gains are in the direction of the family status; but the curves of other children are consistently related to the family status from an early age. In other words, the mental-test records of certain children are in accord with the family pattern as early as 21 months (Figure I, Cases 503,

419, and 435) but others are approaching that level during the entire preschool period (curves shown in Figure II).

V. SUMMARY AND CONCLUSION

Two hundred and fifty-two children who constitute a representative sample of the children living in an urban community were given from 8 to 10 mental tests between the ages of 21 months and 8 years. The California Preschool Schedules I and II were the tests used during the preschool period; the Stanford-Binet at 6 and 7 years; and the new Revision of the Stanford, Form L, at 8 years. Certain environmental variables obtained in a socio-economic appraisal of the child's home soon after his birth have been considered in relation to these test scores. The results may be summarized as follows:

1. The mother's intelligence, the education of the parents, and a composite socio-economic rating of the home show only a negligible relation to the children's mental-test scores on a first test given at 21 months; but by 3½ years statistically significant relationships were obtained between these family variables and the children's test performance.

2. Although the most marked gains in relationship occurred between 3 and 3½ years, the relation of the environmental variables to the children's mental-test scores increased up to the last test given at 8 years.

3. Mid-parent education showed an increasing relationship to mental-test increments, or changes in the children's mental-test scores over the age periods 21 months to 3, 4, 5, 6, 7, and 8 years. The most marked increase in relationship occurred between the third and fourth years.

4. Age changes in the relation of the environmental variables to the children's mental-test scores are substantially the same in two subsamples of the main group, indicating that these are not chance findings but would probably be duplicated under similar conditions of sampling and testing.

5. No systematic tendency was noted for the mother's or father's education to be more closely related to the children's mental scores. In both subsamples, a slightly higher relation between the children's scores and the mother's education is noted at 5 and 6 years, but at 7 and 8 years slightly higher correlations were obtained between the father's education and the children's scores.

6. Of the environmental variables considered, the ratings of the mother's intelligence show the highest correlation with the children's scores. A socio-economic index (based on the father's income and occupation, a social rating, and the education of the parents) is more closely related to the children's scores than the parents' education alone, but not so closely as a rating of the mother's intelligence.

7. Consideration of the mental-test records of children of highly educated parents confirmed the conclusion drawn from the correlation coefficients. These children's scores approximated the group averages on the first test but were for the most part earning above-average scores on tests at 6, 7, and 8 years. Conversely, none of the children of the most poorly educated parents ever made an above-average record, but rather consistently scored below the group average. Greater variations were noted in the scores of individual boys than of individual girls, suggesting that the girls mature or find their 'level' at an earlier age than the boys.

8. The most marked increases in mental-test scores between 21 months and 8 years occurred in families where one or both parents went to college. A high-school education was the least amount of schooling for any parent whose child showed marked gains in scores. In the case of children making markedly subaverage records, parents were usually found to have no more than a grammar-school education.

9. Consideration of the mental-test records of children whose parents differed widely in their education shows that children's scores do not appear to be unduly influenced by either the highly or the poorly educated parent, but rather approximate that of the mid-parent education, regardless of whether the more educated parent is the mother or the father.

These findings have confirmatory value for previous studies in showing age changes in the relation of socio-economic status to the children's mental-test scores for a fairly sizable and representative sample of children, but the results do not give any real clue as to the nature of the obtained relationships. The fact that the children's scores do not seem to be unduly influenced by the mother's abilities and experience suggests that the influence is not entirely an environmental one. Marked individual differences noted in the curves of individual children suggest not only a multiplicity of factors impinging on the child's mental development as expressed in test performances, but also intrinsic differences in rates of mental growth and maturation.

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CHAPTER XII

MENTAL GROWTH AS RELATED TO NURSERY-
SCHOOL ATTENDANCE¹

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The general hypothesis tested by the present study is that the rate of change in mental status (mental growth) is to a measurable degree subject to educational control. We are concerned with mental status as measured by standard intelligence tests; with educational control as exerted through the daily regime of a modern nursery school. The age period under consideration is approximately from 2½ to 4½ years, and the average length of exposure to nursery-school training is approximately 4 semesters. The additional hypothesis, that growth increments stimulated by education are persistent, will be considered; more specifically, that the effects of nursery-school training are observable in mental tests given during later childhood. Here we shall be concerned with intelligence measurements of children from 5 to 9 years of age.

These hypotheses are examined in a study of three groups of children (totalling 54 cases) who have attended the Institute of Child Welfare Nursery School in comparison with several control groups of children who have not attended a preschool but who have participated in a similar program of seriatim mental tests.

The Nursery School was established in the fall of 1927 under a

¹ Assistance in the preparation of these materials was furnished by the personnel of Works Progress Administration Official Project No. 665-08-3-30. Acknowledgment is due to Dr. H. S. Conrad for statistical advice.

grant from the Laura Spelman Rockefeller Memorial. For two years it was maintained as an all-day school, with a noon lunch period; the tuition at this time was \$10.00 per month. Beginning in the fall of 1929, children were taken for a single session only (9:00 A.M. to 12:00 M.), with tuition reduced to \$5.00 per month. All the nursery-school cases included in the present study were in school prior to 1935, at a time when the average enrollment was from 25 to 32. As will appear later, the selection of families represented is not that of the general population, but is distributed around a definitely higher average, both as to cultural-economic status and education of the parents.

It must be stated that the educational objectives of the school have been formulated largely in terms of the encouragement of social habits, motor skills, and varied creative activities, and without special or direct emphasis upon intellectual stimulation. Nevertheless, the nature of the program should in this respect give the school a character similar to that of other leading nursery schools founded in the same period. An able discussion of nursery-school procedures, published from the University of Iowa (11), may be referred to as an expression of a method and a point of view similar to those approved by the experienced teaching staff in the University of California Nursery School. If preschool training significantly advances mental development, it is probable that a variation exists in the effectiveness of different schools. Unfortunately, no method is yet available for the independent measurement of characteristics that would be expected to influence development. Presumably these characteristics can only be determined by locating schools that show a positive influence, and analyzing the nature of this effect through further experimentation.

I. GROUPS I AND IA

The First Berkeley Growth Study has been described in a monograph by Bayley (2). Fourteen members of this sample attended the nursery school, entering at an average age of 27 months. These cases were matched, on the basis of mid-parent education, with 14 others from the same study who had not attended nursery school but who had been given an identical schedule of tests from the age of one month. The following tabulation presents the essential sampling data for these two groups:

	<i>Group I</i> (Nursery School)	<i>Group IA</i> (Control)
Number	14	14
Mean Nursery-School Attendance in Days	261.5	0
Mean Mid-parent Education (years of schooling)	14.5	14.5
Mean Occupational Rating*	1.8	1.8

* A modification of the Taussig Scale was used with the following classifications: 1, professional and executive; 2, semiprofessional, business, and clerical; 3, skilled trades; 4, semiskilled; 5, unskilled.

It will be seen at once that, by cultural and economic criteria, this is a superior selection; the parents averaged more than 2 years of education beyond the high school, and the occupational ratings tend to cluster in the upper brackets of the occupational scale.

Both groups were tested with the California First-Year Mental Scale (1) to 18 months; the California Preschool Schedule I or II¹ to 60 months; the 1916 Stanford-Binet at 72 and 84 months; and the 1937 Stanford Revision, Form L, at 96 and 108 months. All tests were given by Dr. Nancy Bayley. The original test scores have been transformed into sigma scores in terms of the mean and standard deviation of the total growth-study group at each test period.²

Figure I compares the mental-growth curves, in sigma-score terms, for the nursery-school and control groups. The middle horizontal line, drawn at 0, represents the mean of the total growth-study sample. It may be noted that during the nursery-school period the group in school shows a slightly superior performance. This is not, however, statistically significant, and even aside from tests of statistical significance,

¹ These tests are described briefly later in this report, and are reproduced in a monograph by Macfarlane (9).

² The formula used is $x = \frac{X - M_1}{\sigma_1}$, where x = the sigma score, X = an individual raw score; M and σ represent the mean and S.D. for the total group at a given age. The size of sample on which the sigma scores are computed ranges from 43 to 61. For the computation of sigma scores it would be desirable to have a larger and also more constant sample. Variations in the total sample, however, would not be expected to disturb the comparison of subgroups at a given age level, since at each level identical constants are used in transforming raw scores for the two groups.

two considerations would lead to ignoring it: (a) the superiority of the nursery-school group is of the same order as that shown by the same group in the prematching period (6 to 18 months); (b) the superiority decreases rather than increases with continued attendance after three years. Moreover, any apparent superiority of the nursery-school group is lost after 5 years. The striking fact is that both groups maintain an average sigma curve that after 24 months is approximately horizontal and very close to the group mean. The nursery-school group, spending an average of approximately two years (4.2 semesters) in the nursery

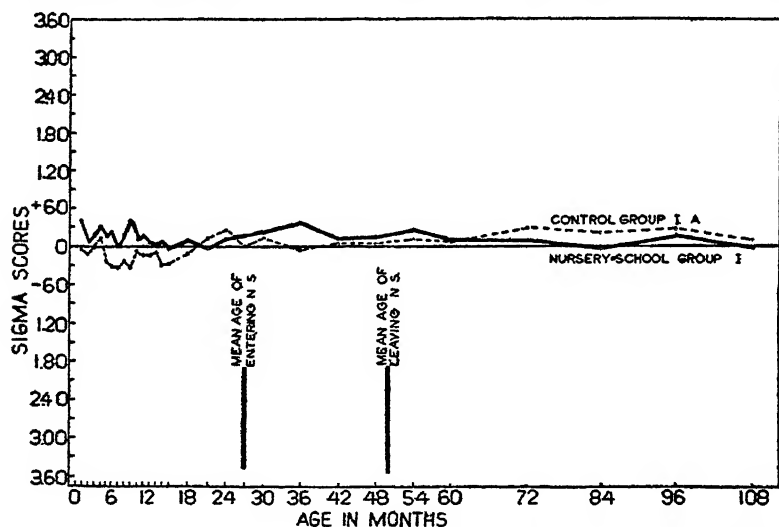


FIG. I.—MENTAL SIGMA-SCORE CURVES OF NURSERY-SCHOOL CASES (GROUP I) AND A MATCHED CONTROL (GROUP IA)

school, give no indication of intellectual gains greater than those found for non-nursery-school cases.

II. GROUPS II AND IIA

The Institute of Child Welfare Guidance Study deals with 126 cases tested first at the age of 21 months and tested later at 24, 30, 36, 42, 48, 60, 72, 84, and 96 months.¹ Eleven cases in this group attended the Institute Nursery School. A control group was set up, consisting of 11 members of the Guidance Study who did not attend

¹The tests in this program were given by members of the Guidance Staff, under the direction of Dr. Jean W. Macfarlane.

a nursery school and who matched most closely on the basis of three criteria: (a) mental-test scores at ages prior to the age when Group II entered nursery school; (b) mid-parent education (average years of schooling of the two parents); and (c) occupational rating. The following tabulation gives the essential sampling data for these two groups.

	<i>Group II</i>	<i>Group IIA</i>
Number	11	11
Mean Nursery-School Attendance (in days)	225.2	0.0
Mean IQ (at entrance age of Group II)	114.9	115.2
Mean Mid-parent Education	13.9	13.5
Mean Occupational Rating	1.6	2.0

The average age at entrance of Group II was 32.7 months, with a range from 24 to 39 months. The average age at leaving school was 52.2 months. The tests administered to both Group II and IIA were the California Preschool Schedules I or II from 21 to 60 months; the 1916 Stanford-Binet at 72 and 84 months, and the 1937 Stanford Revision at 96 months. At each age the original mental-test scores have been transformed into sigma scores based on the performance of the total guidance group. Figure II and the tabulation that follows

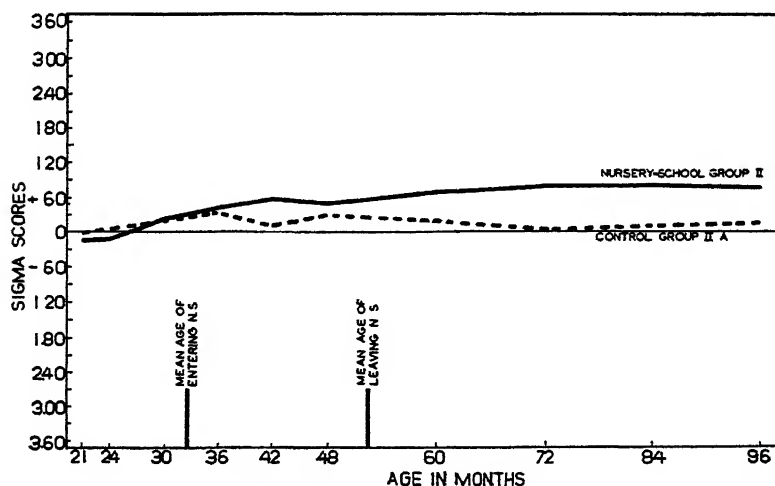


FIG. II.—MENTAL SIGMA-SCORE CURVES OF NURSERY-SCHOOL CASES (GROUP II) AND A MATCHED CONTROL (GROUP IIA)

present the sigma scores, by age, for both the Nursery-School Group and the Control Group.

It may be noted that, whereas the Control Group maintains a position close to, and slightly above, the group mean, with no evidence of trend, the Nursery-School Group shows an apparent upward trend in scores, continuing to 7 years, and reaching a position three-quarters of a standard deviation above the mean of the total guidance group.

	<i>Age in Months</i>									
	21	24	30	36	42	48	60	72	84	96
Group II	— .16	— .15	.21	.42	.53	.44	.67	.76	.81	.76
Group IIA	— .02	.03	.18	.32	.08	.27	.17	.02	.11	.16

Several explanations may be offered for these findings: (a) The most obvious explanation is that the differences represent a random fluctuation in scores; even at the point of maximal divergence of the curves there are only 69 chances in 100 of a true difference in the direction indicated. (b) It may, however, be argued that in this small sample more attention should be given to consistency of trend than to statistical tests of reliability. This consistency of trend suggests that in the present instance the Nursery-School Group is actually demonstrating a stimulation effect from their two years of nursery-school experience—an effect that is not merely maintained but also is increased after the nursery-school period. (c) If the argument from consistency is adopted, it is possible to explain the divergence of the curves in terms of home, rather than school, environmental factors. The second tabulation in this article shows that, while we were successful in matching Groups II and IIA on the basis of initial IQ, we were unable to obtain the desired degree of equivalence in the other criteria. Since correlations between children's mental scores and measures of parental occupational or educational status tend to increase during early childhood (3), it is not unreasonable to anticipate a slightly better growth record for Group II than for Group IIA. It is well known that with reference to such problems as those we are studying here, fully adequate controls are extremely difficult to establish. Even when an exact matching is obtained on various formal measures, the possibility remains that parents who send their children to a nursery school, at some financial sacrifice, may on the average be more alert to the educational needs of their children, and more concerned with providing an adequate psychological environment in the home, than are parents in the same socio-economic level who have a more conservative and matter-of-course attitude toward early education. (d) The possibility should not be overlooked that the divergence of the curves is

due to a random variation in growth potentialities, rather than to differential school or home influences. In view of the fact that individual mental-growth curves *do* show consistent trends, unrelated to known environmental factors (3), it is not surprising that in small samples inequalities should occasionally appear in average growth curves. (e) The variation in growth potentialities may be systematic rather than random. A possibility exists that in the case of the Guidance Group the selection of cases for the nursery school was influenced by the recognition that they were developing more slowly than expected. To the extent that this occurred, Group II would include cases who were initially at a low point in a growth cycle, and who later showed gains due to a resumption of normal growth rather than to specific environmental effects.

These alternative hypotheses have been discussed in greater detail than is justified by the importance of the present study; they illustrate, however, considerations that should not be neglected in any attempt to draw positive conclusions from data on the effects of nursery-school training. They point, also, to the need, not merely of more cases, but also of a greater amount of descriptive data, to assist in the interpretation of individual records.

It may be pointed out that if emphasis is to be placed upon consistency, rather than upon statistical reliability, consistency should be required between this part of the study and other parts. We may now turn to data from a somewhat larger group of cases.

III. GROUP III

Group III consists of all children from the nursery school who were not members of other growth studies, who had been tested at least three times while in nursery school, and whose subsequent mental growth has been followed to at least the age of 8 years, with tests at 60, 72, 84, and either 96 or 108 months. Of the 29 children in this group 17 were boys, 12 were girls. The average age at entrance was 29.4 months, and the average length of attendance 4.9 semesters, or 285 days. The range of attendance was from 158 to 478 days. Groups I, II, and III include no overlapping cases. In basing a sample on cases 8 years of age or older, it was necessary to reach back into the early years of the nursery school, when the test program involved the use of a variety of tests that were being compared in the process of making a new scale. The 29 cases in Group III received during the nursery-school period an average of approximately two tests at each of three testing periods.

The tests principally used were at first the Gesell (6) series, arranged into an age scale; the Merrill-Palmer tests (10); and the Minnesota Preschool Scale (7), which was kindly supplied for our use in a preliminary form by Dr. Florence L. Goodenough. The norms used here are tentative norms based on 100 cases for each 12-month age level.

It should be pointed out that these tests involve considerable overlapping as to content. In a nursery-school sample of 49 cases, Conrad (4) reported intercorrelations (corrected for attenuation) in the neighborhood of .95, for the Minnesota, Merrill-Palmer, and Gesell. On the basis of experience with these tests, items were adapted for use in alternate forms in the California Preschool Schedule I and II.¹ The total test program for the 29 cases in Group III included, during their period of nursery-school attendance, 20 administrations of the Gesell; 25 of the Merrill-Palmer tests; 46 of the Minnesota Preschool Intelligence Scale (preliminary form); 43 of California Preschool Schedule I, and 29 of California Preschool Schedule II. After careful study, the decision was reached to combine the scores of all tests given to any individual at any one test period. In view of the overlapping of items in the same or similar form, differences between these tests at any one age level are probably less than differences in the content of a single scale at the preschool as compared with later age levels. It should also be emphasized that in the present study the purpose in combining tests is to make possible a maximal use of data in comparing group averages at a given age level, and not for the portrayal of the mental growth of individuals.

The conversion of scores from different tests into comparable form was facilitated by the fact that in our total nursery-school sample the Minnesota test was frequently administered in conjunction with some other test. One hundred and fifty-eight dual tests were found at various preschool-age levels for the Minnesota and the Merrill-Palmer; 91 for the Minnesota and Gesell; 227 for the Minnesota and California Preschool Schedule I; 109 for the Minnesota and California Preschool Schedule II.

Conversion tables were prepared that made allowance for standard deviation differences at each age, by means of which any test score from two to five years of age could be converted into a Minnesota equivalent IQ.²

At 6 and 7 years of age the Stanford-Binet (1916 Revision) was used, with the exception of 13 cases who were given either the Minnesota or the California test and whose scores were transformed into Stanford-Binet IQ's by means of a conversion table. At 8 years and upward the Stanford Revision (1937) was used.

¹ A further revision has been published by A. S. Jaffa (8).

² The detailed procedure used, and the conversion tables, are on file at the Institute of Child Welfare, Berkeley.

IV. CONTROL GROUP IIIA

For each of 29 cases in Group III, a matching case was sought from the records of the Guidance Study. Scores from the California Preschool Schedules I and II, administered to this group from 21 months to 5 years, were converted into Minnesota equivalent IQ's by the method already described, and matched cases were selected on the basis of IQ at 30 months and mid-parent education. In two instances, it was necessary to match a single case from the Guidance Study against two cases from Group III. Control IIIA, therefore, consists of only 27 individuals.

V. CONTROL GROUP IIIB

A similar matching procedure was employed among 126 cases from the 1928-1929 Berkeley Survey.¹ The children in this sample received a schedule of mental tests to 96 months similar to that of the Guidance Study, except that no tests were given between 21 and 36 months. The matching was therefore based not on IQ at entrance age (30 months)

	<i>Group</i>		
	<i>III</i>	<i>IIIA</i>	<i>IIIB</i>
Number	29	27	25
Mean Nursery-School Attendance (in days)	285	0	0
Mean IQ at Matching Age	111.7	111.8	112.1
Mean Mid-Parent Education	15.2	15.1	15.2

but on the initial IQ: 30 months for Group III, 21 months for Control IIIB. Because of differences in test content some question may be raised as to the appropriateness of this matching procedure; it will be shown later, however, that at 36 months (the second test for each group) the means remain close together, and hence for purposes of group comparison it may be stated that the two groups are equivalent, not only at the initial testing, but also at a more even age comparison in a second testing for both groups, given (on the average) 6 months after Group III entered the Nursery School.

The comparative sampling data for Groups III, IIIA and IIIB are given herewith:

¹ Tests on this group have been administered by Lucille Allen.

In the following tabulation (and also in Figure III) there are presented the mean IQ's for each group, by age. The terminal tests

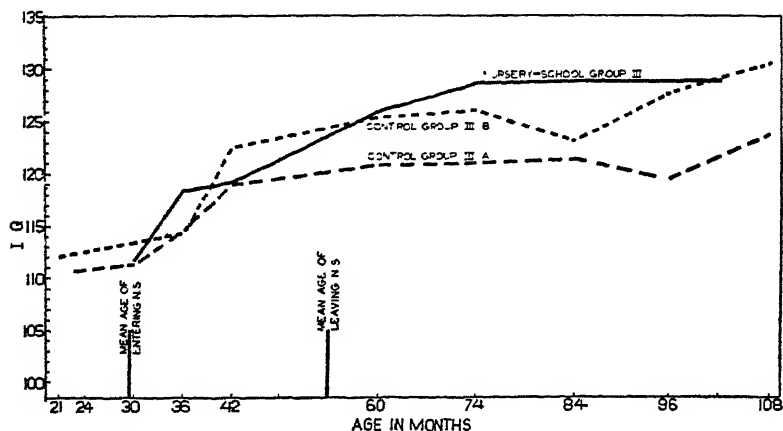


FIG. III.—IQ CURVES OF NURSERY-SCHOOL CASES (GROUP III) AND CONTROL GROUPS IIIA AND IIIB

for Group III were given at either 8 or 9 years, and are plotted at the mean age at which they were administered; for Group IIIA and IIIB tests were given at both 8 and 9 years. Figures I and II, it will be recalled, presented age changes in terms of sigma scores, which

<i>Months</i>	<i>Nursery-School Group III</i>	<i>Control Group IIIA</i>	<i>Control Group IIIB</i>
21			112.1
23		110.4	
30	111.7	111.8	
36	118.0	114.5	114.5
42	119.3	119.1	122.5
60	125.9	120.7	125.4
72	128.6	120.9	126.1
84	128.8	121.2	123.1
96	128.7	119.4	127.6
108	128.7	123.6	130.1

eliminated the effects of practice, as well as other growth phenomena common to both the selected groups and the total samples on which the sigma scores are based. Figure III, in contrast, is in terms of IQ,

and shows upward trends for all groups. These trends may be attributed (a) in part to repeated testing, (b) probably in part to the fact that this is a superior socio-economic selection, with increasing assimilation of the relatively high cultural levels established by the parents, and (c) probably in part also to intrinsic growth characteristics of an innately superior group. We are here concerned, however, with the question whether the growth curve for the nursery-school sample rises more sharply than for the two controls. It is at once apparent that III and IIIB are marked by so many intersections that they may be regarded as indistinguishable; a smoothing of IIIB would bring it extremely close to III throughout the age range. Control IIIA, on the other hand, drops below after 42 months; in other words, during the last few months of the nursery-school period, and in the following year, the Nursery-School Group is continuing to gain in IQ (to 128) while the Control Group is remaining approximately at an IQ level of 120. About as great differences, however, are shown between the two control groups as between IIIA and III; for this no factor other than sampling difference can be used as an explanation.

As a further check on these conclusions, it has seemed desirable to establish matched groups on the basis of IQ's at the end, rather than at the beginning, of the nursery-school period. The greater reliability of mental-test measures at, for example, 60 months, should insure more adequate matching, and, if the nursery school had had a significant effect upon mental growth, this should be revealed in an average curve in which the Nursery-School Group tends to drop below the Control Group in the preschool years. This procedure has certain additional advantages, in that the tests used in the Nursery-School Group and in the Control Group are more nearly identical, and the mean-test ages are identical for all groups.

VI. GROUPS IIIC AND IIID

For each case in Group III, a corresponding case was sought in the Guidance Study, and another corresponding case in the Berkeley

	<i>Group</i>		
	<i>III</i>	<i>IIIC</i>	<i>IIID</i>
Number	29	22	26
Mean Nursery-School Attendance (in days)	285	0	0
Mean IQ at 60 Months	125.9	124.6	126.3
Mean Mid-Parent Education	15.2	15.4	15.0

Survey, matched on the basis of IQ at 60 months and of mid-parent education. The tests used were in all cases California Preschool Schedules I or II (except that four of the older nursery-school cases received the Minnesota test in addition to California I, and three received only the Minnesota test). Obtained scores were transformed into Minnesota equivalent IQ's by the method already described.

The following tabulation (and also Figure IV) indicates that the groups matched at 60 months fluctuate in an unsystematic way both

<i>Months</i>	<i>Nursery-School Group III</i>	<i>Control Group IIIC</i>	<i>Control Group IIID</i>
21	....	....	111.0
23	....	109.6	....
30	111.7	110.8	....
36	118.0	112.5	114.8
42	119.3	120.2	124.8
60	125.9	124.6	126.3
72	128.6	123.4	126.0
84	128.8	127.1	123.3
96	} 128.7	125.7	127.4
108		129.9	129.5

before and after this age. Differences are too small to be significant, and there is no indication that the Nursery-School Group at 60 months has climbed to a comparable IQ from a relatively lower position.

The same procedure was followed in matching the 29 members of the Nursery-School Group tested at either 96 or 108 months with Guidance and Berkeley Survey cases tested at 108 months; the test used was the 1937 Stanford Revision, Form L. The two controls are termed Control Group IIIE and Control Group IIIF. In order not to labor a point already sufficiently emphasized, the table and figure for this comparison will not be reproduced here; suffice to state that the earlier mental-growth curves of the three groups are similar and intersecting. Whereas the hypotheses of a positive and persisting nursery-school influence would lead us to expect lower mean IQ's for the nursery-school group at the beginning of the school period, we find that Group III has an average of 111.6 at 30 months as compared with 112 for IIIE at 30 months, and with 110.5 for IIIF at the nearest comparable test age (36 months).

So far as mental growth is concerned, it is evident that the several groups just discussed represent closely comparable samplings, with no evidence of a growth-promoting factor peculiar to one group only.

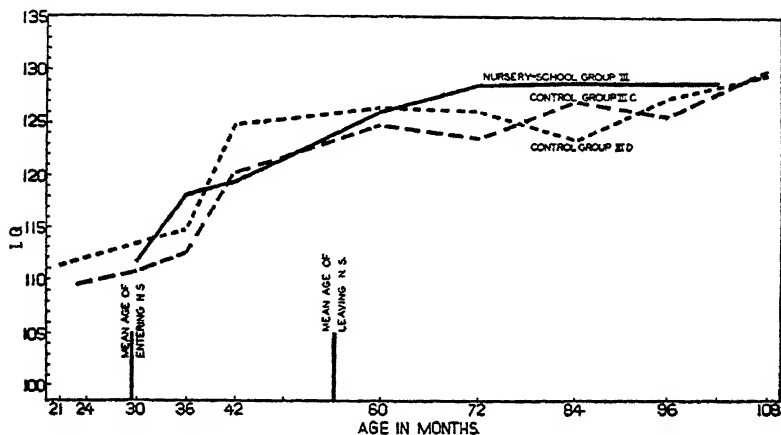


FIG. IV.—IQ CURVES OF NURSERY-SCHOOL CASES (GROUP III) AND CONTROL GROUPS IIC AND IID

We must conclude that the experimental factor (nursery-school attendance) has, under the conditions of this study, no demonstrable significance for mental growth.

VII. THE RELATIONSHIP OF LENGTH OF ATTENDANCE TO CHANGE IN IQ

If nursery-school attendance promotes mental growth, greater IQ gains should be found with longer than with shorter attendance.

1. A frequency distribution for the length of attendance of 66 cases who were tested with California Preschool Mental Scale A in both their first and last semesters of attendance is presented herewith:

<i>Days' Attendance</i>	<i>Number</i>	<i>Days' Attendance</i>	<i>Number</i>
50 to 99	1	300 to 349	10
100 to 149	16	350 to 399	4
150 to 199	17	400 to 449	2
200 to 249	10	450 to 499	1
250 to 299	5		

In this group length of attendance is correlated $.34 \pm .07$ with change in IQ. Longer attendance, however, is associated with a larger number of tests ($r = .88 \pm .02$). On the hypothesis that test repetition is a factor in IQ gains, a correlation was computed between the number of tests and changes in IQ from first to last test; this proved to be $.34 = .07$, or the same as between the length of attendance and changes in IQ. The semipartial correlation technique (5, Formula 21) was applied to eliminate the effect of number of tests from IQ change; the resulting partial coefficient between IQ change and length of attendance is .05.

2. A similar procedure was employed with 68 cases whose nursery-school tests included one of the preschool tests listed previously. Comparable IQ's for these tests were obtained by the method already described. The following tabulation presents a frequency distribution for length of attendance of this group:

<i>Days' Attendance</i>	<i>Number</i>	<i>Days' Attendance</i>	<i>Number</i>
50 to 99	6	300 to 349	3
100 to 149	5	350 to 399	7
150 to 199	17	400 to 449	9
200 to 249	10	450 to 499	4
250 to 299	7		

The following correlations were found:

Change in IQ with length of attendance	$.30 \pm .08$
Change in IQ with number of tests	$.41 \pm .07$
Length of attendance with number of tests	$.85 \pm .03$
Semipartial r for change in IQ with length of attendance, when number of tests is partialled out of change in IQ	— .06

3. Since the effect of length of attendance may be represented more adequately by tests given after the close of the nursery-school period than during the last semester, children were considered among whom attendance ranged from one semester to six semesters, who had been tested by at least one of several preschool scales during the first semester of school, and for whom there had been recorded either a Stanford-Binet IQ (73 cases) or a Stanford equivalent IQ¹ (14 cases) at 6 years of age.

¹ Obtained from a conversion table used with test scores for the Minnesota Preschool Scale or California Preschool Schedule I.

The following correlations were obtained:

Change in IQ with length of attendance	.26 = .07
Change in IQ with number of tests	.47 \pm .06
Length of attendance with number of tests	.49 = .05
Semipartial r for change in IQ with length of attendance, when number of tests is partialled out of change in IQ	.03

It should be noted that in this group there is no relationship between initial IQ and length of attendance ($r = .17 \pm .07$), nor between IQ at 6 years and length of attendance ($r = .12 \pm .07$).

In the second and third of these analyses it is possible that the obtained relationships between change in IQ and length of attendance have been attenuated somewhat by the fact that equivalent IQ's have been used, transformed from scores obtained in a number of intelligence scales. Similar results, however, were obtained in the first analysis, in which the identical test was used for all cases and in both initial and final testing. Under the conditions of the present study, it has not been possible to show that longer nursery-school attendance is more beneficial to IQ's than shorter attendance.

VIII. SUMMARY

1. Fifty-four children who attended the University of California Nursery School were matched with various appropriate control groups on the basis of mean IQ at a given age level and on the basis of years of schooling of the parents. Comparisons of mental-growth curves show no significant differences between the nursery-school and the control groups.

2. Changes in IQ have been examined with reference to the possible influence of length of attendance in the nursery school, for three groups of 66, 68, and 87 cases, representing different test conditions. When allowance is made for the effect of repeated testing, IQ gains are found to be uncorrelated with length of attendance.

The predominantly negative results herein reported are probably not attributable to unreliability of the tests, to noncomparability of different intelligence scales, to lack of suitable controls, nor to substandard procedures, lack of facilities, or lack of trained personnel in our Nursery School. It is, of course, acknowledged that results obtained for this socio-economic selection and for this particular school may not be representative of other samples or other educational programs.

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CHAPTER XIII

INFLUENCING THE RATE OF MENTAL GROWTH IN
RETARDED CHILDREN THROUGH ENVIRON-
MENTAL STIMULATION

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In their study of children in an orphanage environment, Skeels and others (5) have shown that in an unfavorable environment the IQ of young children may be so depressed that it approaches the limits below which we commonly classify the individual as mentally deficient. In our own investigations of mentally defective children, we have recognized a group of children in which a relationship between intelligence, as expressed by the IQ, and the environmental setting can be clearly seen. In this chapter we do not raise the question whether an unfavorable environment alone can cause mental deficiency; we seek only to demonstrate the assistance of a phenomenological relationship between the IQ and the environmental situation in a certain type of mentally defective child.

In children where there is a brain damage (through trauma or disease) or where there is a more general pathological disturbance (syphilis, endocrinic disbalance), there is relatively little discussion regarding the etiological relationship, partial or complete, between the disturbance and mental deficiency. There is, however, a group of mentally defective children in whom no such pathological disturbance can be detected, but to whom the environment appears to have presented definite restrictions against normal socio-psychological development.

It is this type of mentally retarded child that is considered in the present review of a series of studies carried out at the Wayne County Training School, an institution for high-grade moron and borderline children.

In general our data are concerned with three questions. First, do such children in the home environment tend toward a decline in IQ? Second, is this trend reversed when a generally favorable environment is substituted? Third, can a significant rise in IQ be obtained through specialized programs?

I. DECLINE IN IQ IN THE HOME ENVIRONMENT

A group of 50 children (3) admitted to the institution as high-grade moron and borderline defectives (average IQ 67.6) was studied. This group had had an average of 1.7 mental tests per child previous

TABLE I.—SHOWING AVERAGE GAIN IN MENTAL AGE AND AVERAGE LOSS IN IQ PER YEAR OF CHRONOLOGICAL AGE IN TWO ENVIRONMENTAL SITUATIONS

<i>Chrono- logical Age in Years</i>	<i>Community</i>			<i>Institution</i>		
	<i>Num- ber</i>	<i>M. A. Gain</i>	<i>IQ Loss</i>	<i>Num- ber</i>	<i>M. A. Gain</i>	<i>IQ Loss</i>
4	1	8.30	3.20	..	....	...
5	1	8.30	3.20	..	....	...
6	7	8.54	.78	..	....	...
7	13	8.25	.63	..	....	...
8	29	7.83	1.13	..	....	...
9	35	6.98	1.28	6	12.58	-3.75
10	38	6.27	1.59	13	8.79	1.25
11	27	4.41	2.97	23	6.73	1.88
12	21	5.08	2.08	28	5.66	1.58
13	12	3.80	2.28	30	8.59	.10
14	7	3.11	2.60	32	8.10	.38
15	5	8.30	.40	31	8.01	— .03
16	..	...	...	21	7.89	1.00

to admission. In addition, each was examined at the time of admission, making a total of 2.7 tests per child. These tests were distributed over an average interval of 3.8 years. By observing changes revealed by these tests the trend of the IQ during residence in the child's own home was studied.

The amount of mental growth expressed in months of mental-age increase per year of chronological age was computed for each individual subject.

Where tests were given at intervals greater than one year, the amount of mental growth was assumed to have been constant over the interval. In these cases the total gain in mental age was divided by the test-retest interval

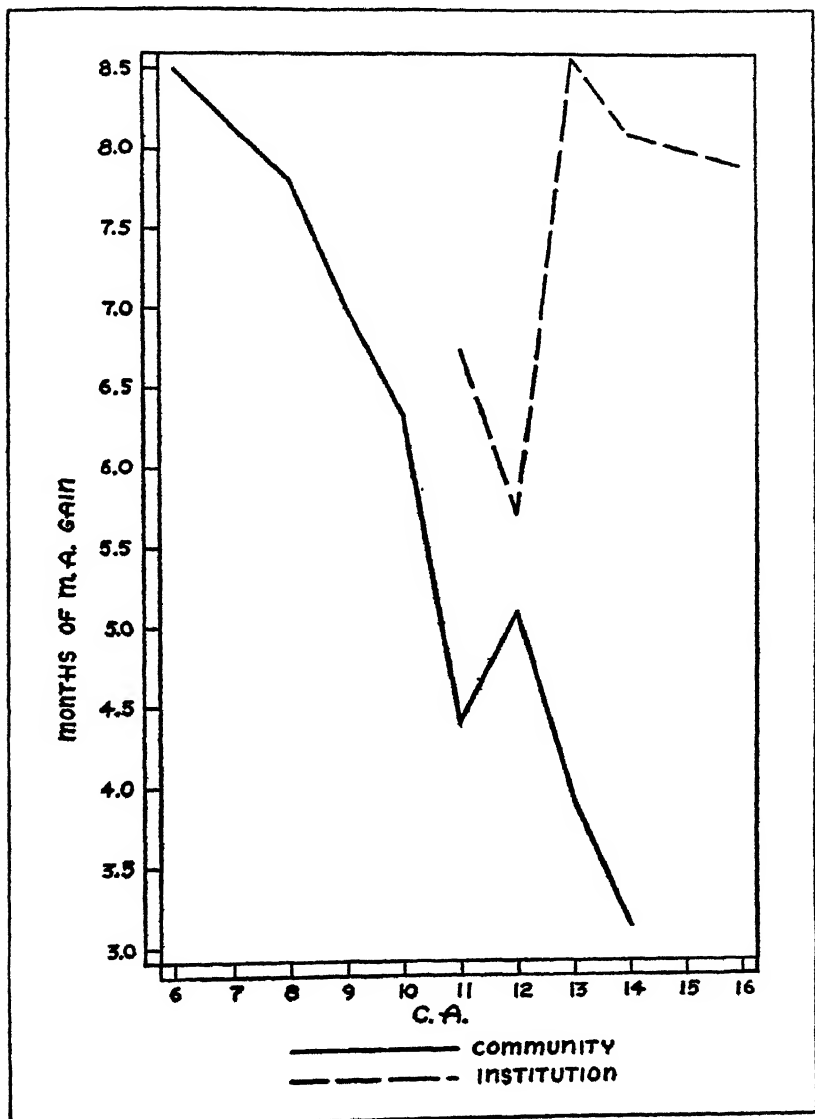


FIG. I.—MENTAL-AGE GAIN PER YEAR

and this figure was assigned to each chronological age level represented in the interval. Thus a child tested at the age of 6, at which test his mental age was 58 months, was retested at the age of 8, at which time his mental age

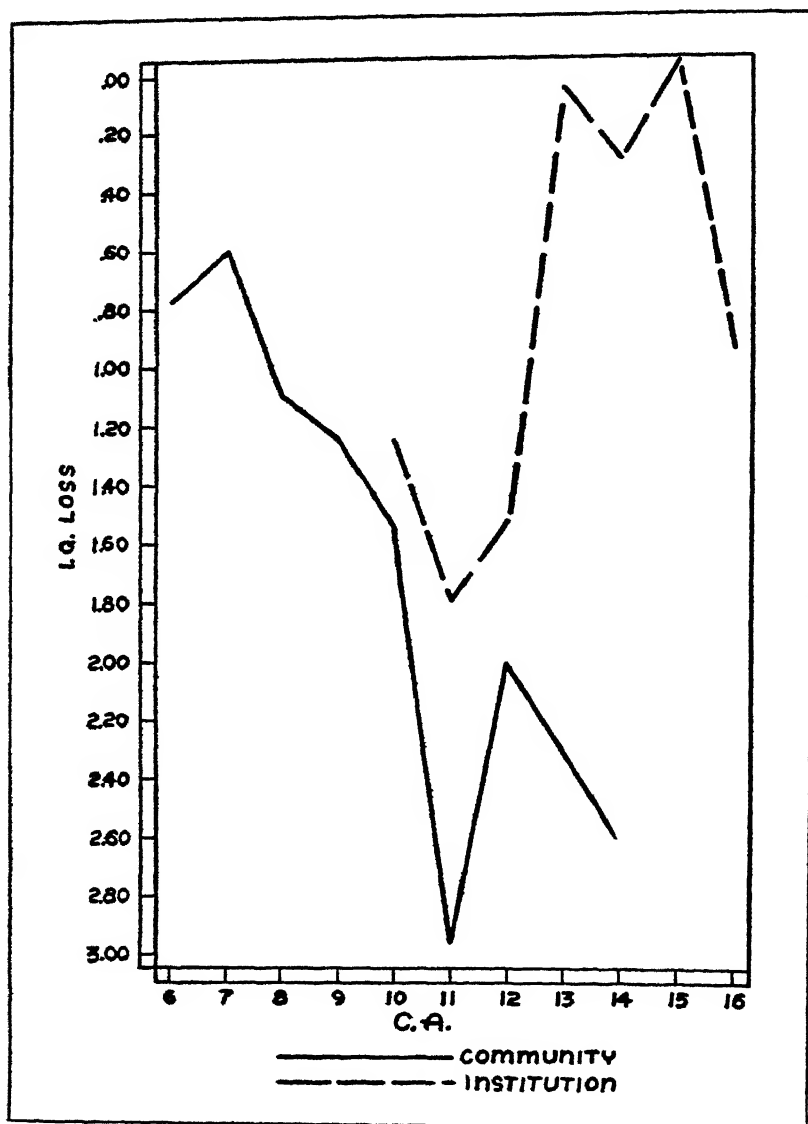


FIG. II.—IQ LOSS PER YEAR

was 71 months. The difference between these mental ages (13 months) was divided by the test interval (2 years) and the result (6.5 months) was entered in each of the chronological ages 7 and 8. From these data the average mental-age gain for each chronological age was then computed.

The results are shown in Table I, whence it will be seen that this group shows an annual decrease in mental-age gain with increasing chronological age, over the period studied. If we consider only those ages at which the number of cases is sufficiently large to be reasonably reliable (between chronological ages 6 and 14), we see that this decrease is fairly regular. These results are shown graphically in Figure I.

When we compute the average loss in IQ per year of chronological age, the same tendency is noted in Table I and Figure II.

We therefore conclude that mentally defective children of this type, while resident in their home environment, show a marked trend toward a decline in the IQ. Similar trends among high-grade moron and borderline children have been noted by Berry (1), Skeels and Fillmore (4), Town (7), and others.

II. EFFECT OF A MORE FAVORABLE ENVIRONMENT UPON THE DOWNWARD TREND

In order to study the effect upon this trend of a change to the generally more favorable environment of the institution, the same 50 children were studied over an average period of residence in the institution of 4.81 years. During this period they had had an average of 3.33 tests per child. The same method was used to compute the average annual gain in mental age or loss in IQ. These results are shown in Table I and are presented graphically in Figures I and II.

It will be seen from these data that this group in the institutional environment showed a tendency to gain in average annual mental-age growth. The former tendency in the child's own home toward relatively rapid loss is strikingly reversed upon admission to the institution. It would therefore appear that substituting a more favorable environment tends to reverse the former trend toward a falling IQ.¹

¹It merits mention here that comparison of these data with similar data regarding a group of 51 children who showed evidence of brain damage was made. The group showing brain damage revealed a much less rapidly falling IQ in the own-home environment. No appreciable effect upon this trend was noted in response to the change of environment. This is in line with our hypothesis that two distinguishable types exist within the group of mental defectives.

Further evidence regarding the influence of the institutional environment is revealed by a study of the mental growth during residence of all children who showed no pathological signs physically, among the first 500 admissions (6). One hundred thirty-nine children of this character were found. These children were studied over an average period of residence of 4.40 years. At the time of the initial test their mean chronological age was 13.8 years; their mean IQ 66. Over the period studied, these children showed an average gain of 4.0 IQ points.

These results would indicate that a generally favorable environment can reverse the trend in mental growth displayed by such children. It must be borne in mind that institutionalization *per se* does not necessarily constitute a favorable environmental change. The results obtained depend, rather, upon the extent to which the program of the institution is directed toward the provision of adequate experience.

III. EFFECT OF A SPECIALIZED PROGRAM

If these results are obtained in a generally favorable environment, can a highly specialized program produce a significant rise in the IQ of these retarded children? An attempt to carry out such a program in the cottage situation has now been operative for 1½ years (2).

The group on which data are at present available is composed of 16 boys ranging in age at the beginning of the experiment from 15 to 18 years (mean age, 16 years, 6 months). Their initial IQ's ranged from 48 to 80 (mean IQ, 66.3).

Limitations of space prohibit a detailed description of the program undertaken.

In general the aim was to stimulate constructive activity with whatever material might be provided. Social approval was directed toward the recognition of productions, concrete or abstract, that showed ingenuity, initiative, and original planning. Only secondary emphasis was placed upon the finished product. The interest of the experimental program was primarily in the child's own original development of means toward the end. Free choice, both of the end and of the means, stimulates ingenuity, spontaneous evaluation of methods, and similar qualities. Such a change of emphasis from more external, to more internal, productivity represents a departure from customary methods of training.

Mental tests given after the beginning of this program of stimulation were compared with earlier tests to learn what changes in IQ

might have occurred as a result of the program. The test-retest interval varied from 6 months to 2 years, 11 months (average interval 1 year, 6 months). In all cases the Stanford-Binet test was used.

The average IQ at the beginning of the program was 66.3; the average IQ as measured by tests given at the end of this phase of the study was 76.4. The difference between these means is 10.1 IQ points. One case only showed negative change (minus 3). The magnitude of the positive changes ranged from 2 to 22 IQ points.

It is often assumed that any IQ change of less than 5 points is not significant. In the present experimental group we find that 81 percent showed an IQ increase of 5 or more points, thus meeting this criterion of significance. It is also significant that 50 percent of this group show an IQ increase of 10 or more points, and four cases, or 25 percent, raised the IQ 15 or more points. Control groups were used to rule out the possibility that this change might be due to uncontrolled factors in the general environment or to changes in the program and technique of testing.

It would accordingly appear that the experimental group has shown a significant gain in IQ as evidenced both by the average gain (10.1 IQ points) and the percentage of individual cases gaining 5 or more points (81 per cent).

A similar program, with certain modifications necessitated by differences in chronological age and institutional setting, was attempted with three 8-year-old boys in the school situation. At the time of the present study, two of them had experienced this program for 14, the third for 8 months.

For these three children test-retest data are available from four measures of mental ability: the Stanford-Binet, the Terman-Merrill-Binet, the Goodenough drawing-of-a-man test, and performance tests. For these four measures the average IQ (or PQ) change in the three subjects was: Stanford-Binet, +7.3; Terman-Merrill, +8.7; Goodenough, +11.0; Performance Test, +14.7. Although the number of cases is admittedly small and each of the tests used has a greater or less degree of unreliability, it is felt that the consistency of the results throughout all tests strongly suggests that there has been a positive change in the rate of mental growth and that this change is of sufficient magnitude to be significant.

IV. CONCLUSION

From the data here presented, we conclude that there is strong evidence to indicate that, with high-grade moron and borderline children of the type described, the rate of mental growth can be significantly increased in a favorable institutional situation by specific programs of stimulation. This change would appear to be possible at both the relatively early and relatively late chronological-age levels.

The results of these studies would suggest that, among children classified as high-grade moron and borderline mental defectives but who show no physical evidence of pathological disturbance, the environment exerts an influence upon the IQ in three ways: first, in the original home environment the IQ shows a tendency to relatively marked decline; second, this tendency is reversed upon substitution of the generally favorable environment of the institution; third, specialized programs can be effective in producing a significant rise in IQ.

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CHAPTER XIV

A FOLLOW-UP STUDY OF A GROUP OF NURSERY-SCHOOL CHILDREN

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I. PURPOSE

The purpose of this study was to ascertain how children in kindergarten, first and second grades, who had spent two years in a nursery school compared with children of their respective grades with reference to certain traits for which measuring instruments were available.

II. SUBJECTS

Two groups of subjects furnished the data for this study. One will be referred to as the Nursery Group and the other as the Non-Nursery Group.

1. Nursery Group

The Nursery Group consisted of children who had spent from 1½ to 2 years, consecutively, in the nursery group of the School of Household Administration, University of Cincinnati, during the school years September 1926 to June 1930, inclusive. The average time spent was 1.9 years. The attendance of these children was distributed as follows: 1926-1928, 7 children; 1927-1929, 9; 1928-1930, 17, making 33 in all who had spent approximately two consecutive years in the nursery group. The total enrollment of individuals in the nursery group during this four-year period was 97.

Through the coöperation of parents in the spring of 1931, the author located 25 of these children in 7 schools in the Cincinnati area (three private schools, and four units of the city public-school system).

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2. Non-Nursery Group

The control group was as nearly a random sampling as conditions permitted. The method of choosing the controls was that of taking the child whose name alphabetically preceded the name of the subject and the child whose name alphabetically followed the name of the subject, keeping grade and sex constant. This procedure yielded a control group of 44 members on whom measures were obtained. The discrepancy in numbers arises because sometimes the subject was the only child of his category in a private school and because the control child was sometimes absent at the time of measuring.

III. DATA

The data for this study, consequently, were obtained from 25 nursery-group children and 44 non-nursery-group children. The author, cognizant of the small number of cases, has applied the statistical formulas devised for use on small samples.¹

Five questions were raised with reference to the two groups:

1. How do the two groups compare as to chronological age?
2. How do the two groups compare as to height and weight?
3. How do the two groups compare as to intelligence?
4. How do the two groups compare as to achievement in reading?
5. How do the two groups compare as to personality development?

With these five questions in mind, the author secured five objective measures and one semi-objective measure on the two groups; namely, measures of chronological age, height, weight, intelligence, reading achievement, personality development.

1. Chronological Age

The chronological age was computed to the nearest month as of May, 1931.

	<i>Range</i>	<i>Mean</i>	<i>P.E.</i>
Nursery Group	54 to 95	75.6	
Non-Nursery Group	52 to 107	78.3	
Difference		2.7	2.23
<i>t</i> Value			1.2

¹ R. A. Fisher. *Statistical Methods for Research Workers*. (Oliver and Boyd: London, 1937) 339 pp.

Reference to a *t* table reveals that when one degree of freedom¹ is involved, the *t* value must be 12.7 on the 5 percent level and 63.6 at the 1 percent level to indicate a significant difference between means. Since the *t* value is only 1.2, the difference is probably the result of errors of sampling and is not significant.

2. Height

The measures of height were taken to the nearest one-tenth of an inch by the member of the respective school staff skilled in obtaining physical measurements. All measurements were obtained during May, 1931.

	<i>Range</i>	<i>Mean</i>	<i>P. E.</i>
Nursery Group	41.5 to 49.1	44.6	
Non-Nursery Group	36.5 to 57.8	45.6	
Difference		1.0	.69
<i>t</i> Value			1.45

As before, the *t* value does not indicate a significant difference between the means.

3. Weight

The measures of weight, taken to the nearest one-tenth of a pound, were obtained at the same time as the measures of height.

	<i>Range</i>	<i>Mean</i>	<i>P. E.</i>
Nursery Group	34.5 to 51.0	44.3	
Non-Nursery Group	34.5 to 70.0	48.7	
Difference		4.4	1.78
<i>t</i> Value			2.4

Again, the *t* value indicates no significance in the difference between means.

4. Intelligence

The intelligence quotients were determined by the author through the application of the 1916 Stanford Revision of the Binet during May, 1931. The summary is in terms of IQ.

¹ G. W. Snedecor. *Statistical Methods*. (Collegiate Press, Inc.: Ames, Iowa, 1937) p. 55.

	<i>Range</i>	<i>Mean</i>	<i>P. E.</i>
Nursery Group	92 to 137	113.6	
Non-Nursery Group	90 to 145	110.6	
Difference		3.0	1.9
<i>t</i> Value			1.2

The *t* value of 1.2 does not indicate a significant difference between the IQ's of the groups.

5. Reading Achievement

Only 13 of the 25 children were in grades higher than kindergarten and receiving instruction in reading. Seven were in the first, and 6 in the second grade. Haggerty Reading Examination, Sigma I, was administered to 5 in the first grade and 5 in the second grade. Three were absent the day of the test. The same test was administered to the controls of these cases. The report is in terms of total score.

	<i>Range</i>	<i>Mean</i>	<i>P. E.</i>
<i>Grade I</i>			
Nursery Group	4 to 15	11.0	
Non-Nursery Group	1 to 14	11.7	
Difference		.7	.32
<i>t</i> Value			.22
<i>Grade II</i>			
Nursery Group	8 to 30	21	
Non-Nursery Group	1 to 37	22.9	
Difference		1.9	4.57
<i>t</i> Value			.41

From the *t* values, the indication is that the difference in reading achievement is not significant.

6. Personality Rating

The personality rating of the two groups was based upon the judgments of teachers who applied the accompanying scale devised by the writer.

PERSONALITY RATING OF YOUNG CHILDREN

Teacher's Judgment of Date.....
 School..... Grade..... Teacher's name.....

Please record your judgment by checking (✓) the degree of each of the following traits shown by.....in comparison with other children in the same grade.

	<i>Lowest</i>		<i>Average</i>		<i>Highest</i>
	5	4	3	2	1
I. Self-Service					
Putting on wraps	|	|	|	|	|
Care of wraps					
Toilet					
Eating habits					
Self-feeding					
	(Same 5-point scale lines continued for each item below.)				
II. Emotional Control					
Thwarted in desire for toy					
Thwarted in desire for manipulating toy					
Thwarted in desire by persons					
Thwarted in desire by routine					
Physical injury from fall					
Physical injury from person—accidental					
Physical injury from person—deliberate					
III. Social Adjustments					
Leadership—starting group play					
Initiative—starting own activity					
Sharing—toys or opportunity					
Group or solitary play—for most part					
Enthusiastic participation					
Popularity with children in the group					

Each point placed on the scale by a teacher was given a numerical value. An attempt to secure three complete teacher ratings on each child was unsuccessful, but it was possible to obtain ratings for each child by two teachers. The measure used in the study is the average of the two ratings.

The variation between the Nursery Group and the Non-Nursery Group with reference to the 18 variables in the scale was treated by the statistical procedure of analysis of variance. Only the summary table is given.

<i>Source</i>	<i>Degrees</i>		<i>Mean</i>	<i>F</i>	<i>F05</i>	<i>F01</i>
	<i>Sum of</i>	<i>of Free-</i>				
	<i>Squares</i>	<i>dom</i>	<i>Square</i>			
Total Variance	3.4717	35				
Interclass Variance	2.3844	1	2.3844	44.65	5.45	8.40
Intraclass Variance	.1792	17	.0105	.19	2.29	3.27
Residual	.9081	17	.0534			

Reference to an F-table¹ reveals that when the degrees of freedom are 1 for the greater mean square, and 17 for the smaller mean square, F at the 5 percent level is 4.45 and at the 1 percent level, 8.40. The F in our problem is 44.65. This would indicate that the difference between the two groups with reference to personal adjustments as measured by this scale is significant. The mean was 47.51 for the Nursery Group and 44.97 for the Non-Nursery Group. The superiority is in favor of the Non-Nursery Group, since on the rating scale, the smaller the numerical value, the higher the adjustment.

IV. SUMMARY

A group of 25 children whose average attendance at a nursery school had been 1.9 years was compared with a control group of 44 children of like grade and sex.

The comparison of the two groups has been made on a basis of chronological age, height, weight, intelligence quotient, reading achievement, and personality development.

There is no significant difference between the two groups with reference to chronological age, height, weight, intelligence quotient, or reading achievement.

There is a significant difference between the groups with reference to personal adjustments, as measured by teachers' judgments recorded on a rating scale. But, the superiority is in favor of the Non-Nursery Group.

V. Conclusions

So far as the present study is concerned, the inference is that nursery-school experiences neither increase nor decrease intelligence quotients. Neither do such experiences affect height, weight, or reading achievement, nor increase social development over that of non-nursery-school children.

¹ Snedecor. *Op. cit.*, pp. 174-177.

CHAPTER XV

SUBSEQUENT GROWTH OF CHILDREN WITH AND WITHOUT NURSERY-SCHOOL EXPERIENCE

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The invitation to analyze local experiences with respect to the effects of nursery-school attendance upon mental development came to the writers while engaged in the preparation of a longitudinal study concerned with the growth of the child as a whole. In this study were involved all children for whom there was a minimal consecutive set of records representing 5 annual measurements for a span of 4 years. The maximal record was approximately 8 years in length. Complete records meeting the definition were available for 28 boys and 28 girls. Of these, 9 boys and 19 girls had attended nursery school; the others had begun their school experience with the kindergarten or later. It thus becomes easily possible to add a fragment of evidence to the problem of the effects of nursery-school attendance by contrasting the subsequent growth of these two groups. If the present report had been a planned experiment, rather than a by-product, the laboratory would have undertaken to carry from preschool ages a control group of children not attending nursery school.

I. SOCIO-ECONOMIC SELECTION

The school is located contiguous to the University campus and is largely surrounded by rooming houses for students. Younger children particularly must then be transported from outlying residential areas, the nearest of which are heavily populated by persons employed by the University. A \$50 per semester charge for laundry, food, and supplies in the nursery school and a corresponding charge of \$15 in the kinder-

TABLE I.—SOCIO-ECONOMIC CLASSIFICATION OF CHILDREN
IN THE UNIVERSITY ELEMENTARY SCHOOL

Classification*	Nursery School			Non-Nursery School			Total	
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls
I. Professional	9	14	23	12	4	16	21	18
II. Business, Clerical, etc.	0	5	5	7	5	12	7	10
Total	9	19	28	19	9	28	28	28

* Based on F. L. Goodenough and J. E. Anderson, *Experimental Child Study*. (D. Appleton-Century Co.: New York, 1931) 546 pp. (p. 546)

garten and grades for supplies constitute additional factors of economic selection. The extent of the geographic and economic selection in the school as a whole and in the nursery school in particular is obvious in Table I. The children are primarily (70 percent) in the professional classification. Three cases in Group III have been treated with fourteen in Group II for the remaining 30 percent. However, 82 percent of the Nursery-School Group is in Group I as contrasted with 57 percent of the Non-Nursery Group.

II. THE NURSERY-SCHOOL PROGRAM

Since September, 1930, the University Elementary School has operated a nursery-school unit in which children may spend varying periods of time up to two school years. Children usually continue through the kindergarten, the grades, and the high school. The definition of a 'nursery-school child' throughout the period has been a child between $2\frac{1}{2}$ and $4\frac{1}{2}$ years of age as of September first of the year of entrance. In some years no child as young as 30 months was actually accepted, but in all cases a child as old as 54 months was placed in the kindergarten group. The nursery-school groups have varied in size from 12 to 18 children and have always been in charge of selected nursery-school teachers trained in laboratory centers to the extent of the degree of Master of Arts. The daily regimen included typical nursery-school activities with a noon lunch and afternoon nap provided at the school. The environment included opportunities for outdoor and indoor play, art activities, music, the examination of picture books, and a variety of social experiences. Health measures included required immunization for diphtheria and smallpox, daily inspection, exclusion for illness, and health recommendations to parents and teachers.

Conferences between parents and teacher on the child's experiences and progress with written reports have been typical approaches to insuring a mutual understanding of the optimal program for each child.

III. RECORDS

A rather elaborate record-keeping plan for research purposes appraises by serial methods the physical, mental, social, and emotional development of the child throughout his educational experience. The

Kuhlmann-Binet individual mental examination has been administered annually to each child. Routine physical examinations include measures of height, weight, carpal ossification, eruption of teeth, and many others that need not concern us here. Batteries of achievement tests are also administered beginning with the first grade. The writers have recently introduced the term 'organismic age' to represent the mean maturity of growth for each child after all measures have been changed to an age equivalent.

In the present report 'organismic age' is the mean of height age, weight age, carpal age, dental age, grip age, mental age, and reading age, with the exception that reading ages were not obtainable for children below 6 and dental ages based on the permanent teeth could not always enter into the calculation for each child. For its possible interest organismic age, as well as mental age, has been carried through the various comparisons in this report.

The comparisons have been made by reading values for each child at even age points from 3 to 13 years from large graphs on 17 in. x 22 in. cross-section paper.

IV. UNCONTROLLED COMPARISON OF GROWTH OF NURSERY AND NON-NURSERY CHILDREN

A simple contrast of the growth of children with and without nursery-school experience, as in Table II, for the period of 36 to 156 months indicates a superiority for those who attended nursery school. At every age the column of values for the total group gives an equal or higher maturity value in mental age and organismic age for those with nursery-school attendance. The contrast for the girls is more marked than the total trend, and slight inversions in direction occur in the comparisons for the boys.

V. CONTROLLED COMPARISON OF GROWTH OF NURSERY AND NON-NURSERY CHILDREN

It is evident from Table I, however, that the socio-economic classification for children in the Nursery Group is higher than in the Non-Nursery Group and that this is particularly true for the girls in the sample. Accordingly, Table III has been compiled for those children whose fathers' occupations fall in the professional group. The small number

TABLE II.—SUBSEQUENT GROWTH OF CHILDREN WITH AND WITHOUT NURSERY-SCHOOL EXPERIENCE WITH NO CONTROL OF SELECTIVE FACTORS

Chrono- logical Age	Boys			Girls			Total		
	Num- ber	Men- tal Age	Organ- ismic Age	Num- ber	Men- tal Age	Organ- ismic Age	Num- ber	Men- tal Age	Organ- ismic Age
<i>Nursery</i>									
36	2	48	50	5	47	47	7	47	48
48	6	59	53	17	64	58	23	62	57
60	8	72	67	19	75	68	27	74	68
72	8	85	77	19	86	78	27	86	78
84	9	97	91	19	100	92	28	99	91
96	9	111	104	19	115	105	28	113	104
108	9	127	117	19	129	119	28	129	118
120	9	143	130	15	148	135	24	146	133
132	4	169	144	10	171	156	14	170	153
144	2	153	149	3	174	167	5	165	160
156	0	...	...	0	...	...	0	...	...
<i>Non-Nursery</i>									
36	0	..	..	0	..	..	0	..	..
48	0	..	..	0	..	..	0	..	..
60	10	75	67	4	69	71	14	73	68
72	14	81	73	9	84	81	23	82	76
84	17	97	86	9	95	92	26	96	88
96	18	112	100	9	108	105	27	111	102
108	18	128	114	9	123	120	27	126	116
120	18	139	126	7	139	133	25	139	128
132	15	150	138	6	149	146	21	150	141
144	12	165	152	2	159	144	14	164	151
156	7	161	161	1	180	165	8	163	162

of children in the nursery school from Group II did not warrant statistical comparisons. The differences in growth in mental age and organismic age are rendered negligible by this amount of control of selective factors. The sample of nursery-school girls retains its superiority while the non-nursery boys are superior to the nursery boys. The small difference in the subsamples and the total are probably attributable to the size of the samples and the approximate degree of the control of selective factors.

TABLE III.—SUBSEQUENT GROWTH OF BOYS AND GIRLS FROM PROFESSIONAL HOMES WITH AND WITHOUT NURSERY-SCHOOL EXPERIENCE

Chrono- logical Age	Boys			Girls			Total		
	Num- ber	Men- tal Age	Organ- ismic Age	Num- ber	Men- tal Age	Organ- ismic Age	Num- ber	Men- tal Age	Organ- ismic Age
<i>Nursery</i>									
36	2	48	50	3	48	45	5	48	47
48	6	59	53	12	64	58	18	63	57
60	8	72	67	14	76	67	22	74	67
72	8	85	77	14	86	78	22	86	78
84	9	97	91	14	100	91	23	98	91
96	9	111	104	14	115	104	23	113	104
108	9	127	117	14	131	118	23	129	118
120	9	143	130	10	150	135	19	146	133
132	4	169	144	7	173	157	11	171	153
144	2	153	149	1	188	170	3	164	156
156	0	...	...	0	...	...	0	...	...
<i>Non-Nursery</i>									
36	0	..	..	0	..	..	0	..	..
48	0	..	..	0	..	..	0	..	..
60	8	78	70	2	66	73	10	76	71
72	10	85	76	4	84	82	14	85	78
84	12	101	89	4	95	92	16	99	90
96	12	115	103	4	107	106	16	113	104
108	12	131	118	4	119	121	16	128	119
120	11	147	132	2	131	129	13	144	131
132	9	156	144	2	151	148	11	155	144
144	8	167	154	1	168	155	9	167	154
156	4	155	157	1	180	165	5	160	158

VI. LENGTH OF ATTENDANCE AND SUBSEQUENT GROWTH

Children defined as nursery-school children in this study may have been enrolled for a period of time varying from one semester to four semesters. While enrolled they have had various percentages of attendance depending upon health, travel, and similar factors. For a determination of the possible effects of length of nursery-school experience, the total group was split according to days of attendance. The children in the upper half attended from 159 to 300 days with a mean of 225 days,

while the children in the lower half attended from 32 to 153 days with a mean of 117 days. The method ignores a possible slight selective factor involved in the relation of health to the percentage of attendance.

The subsequent growth of these two groups, all of whom have had some nursery experience, is contrasted in Table IV. There is a slight advantage in organismic age for longer attendance in the column of

TABLE IV.—SUBSEQUENT GROWTH OF NURSERY-SCHOOL CHILDREN
CLASSIFIED ACCORDING TO LENGTH OF ATTENDANCE*

<i>Chrono- logical Age</i>	<i>Boys</i>			<i>Girls</i>			<i>Total</i>		
	<i>Num- ber</i>	<i>Men- tal Age</i>	<i>Organ- ismic Age</i>	<i>Num- ber</i>	<i>Men- tal Age</i>	<i>Organ- ismic Age</i>	<i>Num- ber</i>	<i>Men- tal Age</i>	<i>Organ- ismic Age</i>
<i>Lower Half (32 to 153 Days)</i>									
36	0	..	..	1	48	37	1	48	37
48	2	57	52	8	66	56	10	64	55
60	4	75	68	10	76	66	14	75	67
72	4	88	78	10	86	76	14	86	77
84	4	104	90	10	101	90	14	102	90
96	4	112	104	10	114	103	14	114	103
108	4	123	116	10	128	118	14	126	117
120	4	146	130	8	144	130	12	144	130
132	2	169	143	5	156	150	7	159	148
144	1	167	152	2	167	168	3	167	162
156	0	...	...	0	...	...	0	...	...
<i>Upper Half (159 to 300 Days)</i>									
36	2	48	50	4	46	49	6	47	49
48	4	60	54	9	61	60	13	61	58
60	4	69	67	9	75	70	13	73	69
72	4	82	77	9	87	80	13	86	79
84	4	92	92	9	98	93	13	96	93
96	4	112	104	9	115	107	13	114	106
108	4	134	120	9	131	120	13	132	120
120	4	146	132	7	153	140	11	151	137
132	1	210	159	5	186	162	6	190	162
144	0	...	...	1	188	166	1	188	166
156	0	...	...	0	...	...	0	...	...

* One boy with nursery attendance of unknown length at another institution omitted from these comparisons.

totals at all ages and for most ages for the separate comparisons of boys and girls. The most stable points are in the period 60 to 108 months, when the maximal number of children enters into each determination. A slight superiority in mental age for shorter attendance appears at chronological age 60 months, no difference at chronological age 72 months, 6 months in favor of shorter attendance at chronological age 84 months, no difference at chronological age 96 months, and 6 months in favor of longer attendance at 108 months of age. The fluctuating nature of these differences suggests simply a random trend. Length of nursery-school attendance apparently has not been influential in the subsequent mental growth of these children.

VII. SUMMARY AND CONCLUSIONS

An uncontrolled comparison of the subsequent growth of children with and without nursery-school experience demonstrates a superiority in mental and organismic age for those with the experience. By confining the comparisons to children of parents in the professional group the differences disappear. Within the Nursery-School Group, children who attended an average of 225 days each in the preschool period could not be regularly and significantly differentiated in growth from those who attended an average of 117 days.

The analysis has failed to find any conclusive evidence for growth changes related to nursery-school experience in this privileged group of children. One might argue on theoretical grounds that the home nurture for these children was already so nearly optimum, irrespective of nursery-school attendance, that further stimulus and regimen could not be expected to alter the growth curves in mentality or other areas. Where children are living under some degree of deprivation, additional nurture might more nearly permit the realization of potential growth in achieved growth. Such demonstrations must come from experiments with other types of children.

The present study has not examined directly the extent of realization of objectives of the nursery school in social and emotional development.

CHAPTER XVI
THE COURSE OF MENTAL DEVELOPMENT IN SLOW
LEARNERS UNDER AN 'EXPERIENCE
CURRICULUM'

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I. CLAIMS FOR A CAREFULLY PLANNED CURRICULUM
OF EXPERIENCES

During the last few years vigorous claims have been advanced that intellectual growth of children is significantly influenced by the type of school attended; for instance, that children enrolled in schools where the curriculum looks to life experiences for its enrichment rather than placing the major emphasis on textbook verbalization show permanent gains in intelligence as measured by intelligence tests. Similarly, that children in the 'usual' school environment remain at the same level of intelligence, and that a very inferior school environment will have a depressing effect upon the intelligence (6).

II. ORGANIZATION AND AIMS OF THE SPEYER SCHOOL

Public School 500, Speyer School, conducted under the joint supervision of the Board of Education of New York City and Teachers College, Columbia University, is an experimental attempt to adapt the educational program specifically to two groups of deviate children, the superior and the dull-normal. In this study we are presenting data on the intellectual development of only one of these groups, the dull-normal.

Shortly before the school was opened, early in 1936, the principals of the various elementary schools in the neighborhood were asked to recommend children from their schools who were not making satisfactory school progress and who they believed would profit from the program planned for the slow learners at the Speyer School. Six classes of 25 children each were organized as of February 1, 1936. Originally it had been planned to have one class devoted entirely to the development of a remedial reading program with children of normal intelligence who had definite reading disabilities. After the first term of school this class was disbanded and replaced by other children selected on the same basis as the other six classes. Although it was planned to keep these classes within the intelligence classification of the dull and the dull-normal (that is, of those with an IQ of from 75 to 90), several children were sent to Speyer with IQ's above the upper limit of this classification who were decided school failures. Likewise, a few pupils with IQ's below 75 were included.

The curriculum for the slow-learning group is an elastic one. Its general nature may be best described as a "modified experience curriculum" (1). Each term the various classes select a unit of work or 'center of interest' around which much of their activity is organized. Extensive use is made of trips to museums and points of interest, of motion pictures, and of other visual devices. Speakers from outside the educational world extend the children's horizon. Both the Board of Education and Teachers College provide special teachers in numerous fields, such as general science, art and music, speech correction, nutrition, and physical education. The children have access to not only the school library but also the nearby public library and the libraries of Teachers College. They are guided in their use of these by the classroom teachers as well as by the librarians. In addition to these library facilities, use is made of reading material prepared by workers on a WPA project within the building. This material, which is related to the interests of the various classes, is written on a level consistent with the children's reading ability. Classroom teaching in the various skill subjects is augmented by special remedial classes outside the classroom. These are conducted daily for all children who need this extra help. The classes are much smaller than those from which the pupils originally came, and the individual pupils receive much more attention from the teachers. The school also works in co-operation with the Guidance Laboratory at Teachers College, to

which are referred for intensive study children who present serious emotional problems. In brief, the Speyer School is not the 'usual' school, but a unique departure from the 'usual' pattern, based on the needs and life experiences of the type of child with whom it deals. That the set-up of Speyer School is stimulating to the interests of the pupils and is adapted to their needs is indicated by the fact that the problem of truancy, so prevalent in the IQ range between 75 to 90, is eliminated in this school.

What, then, is the effect of these unusual experiences on the intelligence of the children attending the school?

III. PLAN OF EXPERIMENT AT SPEYER SCHOOL

The material in this report includes test scores for 111 cases, or all but four of the children now in Speyer School (a) who have been enrolled in the school for a period of at least 2 years, or the equivalent of 4 school terms, (b) for whom there was a record of an intelligence test given by an examiner recognized by the school at the time of entrance, and (c) who had not passed the fifteenth birthday at the time of the retest.¹

After the first term of school in 1936, most of the children in the remedial reading group were returned to their regular grades in the schools from which they came, although a few with IQ's below 90 were retained in Speyer School. The other children who were in the school during the first year of its existence have been transferred to other schools because of the removal of their families from the school district.

For the most part the residents in the neighborhood of the school fall in the lower economic brackets. It is a recognized fact that in a large city, families on the lower economic levels move much oftener than do families of more stable income groups, either because of eviction or of search for better living conditions. No other factor than this one of economic pressure can be found to account for the large number of the original group of children who have left the school during the last 3 years. The 'turn-over' in this IQ range is very large the city over. In all, 105 children who entered the school during its first year had left before the retesting program was started. Their average time of attendance at Speyer School was 9.7 months. The average IQ for

¹ Of the four children meeting the above requirements and not included in the study, three were in quarantine at the time of the retesting program and one was excused at the request of the mother.

all of the withdrawals was 87.42. When the fourteen children with IQ's over 100 who were in the remedial reading class the first term are excluded from the distribution, this mean IQ drops to 84.45. Since the mean IQ for the group remaining in Speyer School two years or longer is 85.12, it is evident that the selective factor that caused the removal of all but those children indicated was not one of intelligence.

The arbitrary interval of at least two years' attendance in the school was adopted to allow sufficient time for the child to become thoroughly adjusted to the new situation, and for its influence, if any, to become effective in changing the IQ. However, one investigator (6) asserts:

A permanent change in intellectual standing can be affected in one to one and one-half years that will last at least four to eight years, up to an average age of twelve years, provided that the children are in schools such as the "other schools" of this study. (p. 80)

It is not clear what this investigator means by an intellectual change "that will last." Since the Speyer School was only 2 years, 9 months, old when the retesting program was begun, and 3 years, 3 months, old when it was finished, any change in IQ affected by the school surely will not have disappeared.

The 1918 Revision of the Stanford-Binet Intelligence Scale was used for both the first test and the retest. All tests were given by qualified examiners. Only 15 of the first test and the retest were given by the same person. The scoring on all test blanks in both series of tests was checked by a second individual.

IV. DATA SECURED IN FIRST TEST AND SECOND TEST COMPARED WITH DATA OF OTHER EXPERIMENTERS

When the first tests were made, the chronological age range of the children was from 5 years, 8 months, to 12 years, 3 months. At the time of the second test, the chronological age range was from 8 years, 2 months, to 14 years, 9 months. On the first test, 74 children had IQ's between 75 and 90; 23, between 91 and 95; 5, between 96 and 100; and 1 child, 104. At the other extreme, 8 children had IQ's between 70 and 74; and 2, between 60 and 65.

From Table I it will be seen that the mean difference in first and second IQ's computed by disregarding gains or losses was 5.5. This slightly exceeds the results of other investigators. The 1918 study by Terman (5) of 435 cases taken from all types of schools reports a

TABLE I.—A SUMMARY OF THE DATA ON RETESTS WITH THE 1918 REVISION OF THE STANFORD-BINET INTELLIGENCE SCALE OF 111 SLOW-LEARNING CHILDREN AT SPEYER SCHOOL CLASSIFIED ACCORDING TO AGE LEVEL AT TIME OF SECOND TEST

Age Level	Cases	Sex		Mean Number of Years in the Speyer School	Mean IQ		Time Interval between Tests	Mean Dif- ference between First and Second Test*	Central Tendency of Change between First and Second
		Boys	Girls		First Test	Retest			
8 years to 8 years, 11 months	12	5	7	2 years, 6 months	86.92	92.25	2 years, 7 months	5.66	Plus 5.33
9 years to 9 years, 11 months	16	11	4	2 years, 9 months	86.40	91.20	2 years, 9 months	6.27	Plus 4.80
10 years to 10 years, 11 months	15	9	6	2 years, 9 months	85.66	88.93	2 years, 9 months	6.73	Plus 3.27
11 years to 11 years, 11 months	22	10	12	2 years, 7 months	84.50	83.86	2 years, 6 months	3.18	Minus 0.64
12 years to 12 years, 11 months	14	10	4	2 years, 9 months	87.29	88.43	2 years, 8 months	5.86	Plus 1.14
13 years to 13 years, 11 months	18	7	11	2 years, 10 months	62.94	62.22	2 years, 9 months	5.50	Minus 0.72
14 years to 14 years, 11 months	15	10	5	3 years, 0 months	83.33	79.93	2 years, 11 months	6.47	Minus 3.40
Total group	111	62	49	2 years, 9 months	85.12	86.23	2 years, 8 months	5.51	Plus 1.11

* Disregarding all plus and minus signs.

probable error of 4.5 between the first and second test. Rugg and Colloton (3), reporting in 1921 on 137 Lincoln School pupils, a school that is generally considered to be rich in experience situations, show an average change of 4.7. Poull (2), in a study of mental defectives in an institutional situation, reports an average difference of 4.6. That the Speyer group exhibits slightly greater variability between the IQ's on the first and second test is further borne out by the correlation coefficient of .70. The data given by Terman show a correlation of .93 between the first and second tests; those by Rugg and Colloton, a correlation of .84.

The central tendency of change for the total of the Speyer group is illustrated by plus 1.11. When classified according to age at time of retest, greater differences in central tendency are found. The increases at the 8-, 9-, and 10-year levels might indicate that the children who entered the Speyer School at an earlier age are more likely to show a *small* gain in IQ than those who entered at a later age. There is a decrease in IQ with increase in age. This accords with the general evidence that as the upper limit of general growth is approached, the IQ tends to show a slight decline. Referring again to Terman's 435 retests (5), we find the central tendency of change to be plus 1.7. Likewise, Rugg and Colloton (3) found a median change of plus 1.6.

Of greater interest than the point of central tendency is the distribution as a whole on the retest. From Table II it may be seen that 58.5 percent of all cases fall within a range of plus 5 and minus 5. The middle 50 percent of changes lies between the limits of plus 6.05 and minus 3.03. Thus the positive differences are practically two times as large as the negative differences. The middle 50 percent differs but little from those in the Terman (5) study. The limits for the middle 50 percent of his group fell between an increase of 5.7 and a decrease of 3.3 points. In the group studied by Rugg and Colloton (3), the limits of the middle 50 percent were a 5.6 increase and a 2.3 decrease. The central tendency of change thus falls slightly above zero in all these investigations, regardless of curriculum.

Of the children in the Speyer school, 13.5 percent showed differences in retest of more than 10 IQ points. Rugg and Colloton (3) found that 12 percent of all cases had differences of more than 10 IQ points. In Terman's group (5), 67 out of his 435 cases, or 15 percent, had changes greater than 10 IQ points. The three sets of data agree very closely.

TABLE II.—CHANGES IN IQ ON RETEST FOR 111 SLOW-LEARNING CHILDREN
CLASSIFIED ACCORDING TO AGE AT TIME OF RETEST

Changes in IQ	Age at Time of Retest												Total		
	8-9 Years		9-10 Years		10-11 Years		11-12 Years		12-13 Years		13-14 Years			14-15 Years	
	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent		Num- ber	Per- cent
Above +20			1	6.7										1	0.9
+16 to +20			2	13.3										2	1.8
+11 to +15	2	16.7					3	21.4	2	11.1	1	6.7		8	7.2
+6 to +10	3	25	4	26.7	5	33.3	2	9.1	1	7.1	1	5.6	1	17	15.3
+1 to +5	4	33.3	6	40	3	20	7	31.8	3	21.4	4	22.2	1	28	25.2
Zero	2	16.7					1	4.5	1	7.1				4	3.6
-1 to -5	1	8.3	3	20	4	26.7	10	45.5	3	21.4	6	33.3	6	33	29.7
-6 to -10					2	13.3	2	9.1	2	14.3	5	27.8	3	11	12.6
-11 to -15									1	7.1			2	3	2.7
-16 to -20													1	1	0.9
Total	12		16		15		22		14		18		15	111	

The extremes in change of IQ varied from one case with a gain of 25 points to one with a loss of 18 points. It is of interest to note the following comment that appears on the first test of the child who gained 25 points: "Serious speech defect. Examiner unable to understand her speech. Gave most of manipulation tests." During the two years and seven months that this child has been in the Speyer School, she has been given individual work in speech correction. The two next largest gains were one of -19 and one of +16.

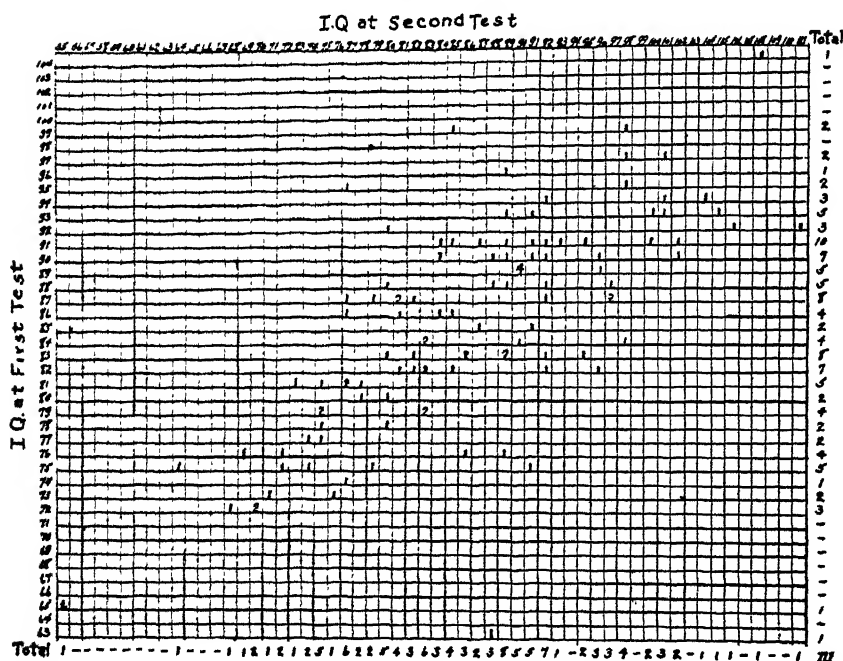


FIG. I.—A COMPARISON OF FIRST AND SECOND TESTS BY THE STANFORD-BINET SCALE FOR 111 SLOW-LEARNING CHILDREN
(CORRELATION .704)

These extreme changes approximate the results of Rugg and Collo-ton (3), who found no differences greater than +17 and -15; they do not begin to approach the results reported by Wellman (7), who cites cases of children attending an 'unusual' school who show gains of from 41 to 67 points over periods of time extending from 1½ to 7½ years. Wellman says of these cases: "These children are not atypical, but are representative of a fairly large group."

In the same article (7) Wellman goes on to say: "It is clear from the illustrations that children can and do change in test IQ from average to genius and from average to feeble-mindedness." Our data presented in Figure I do not show this to be the case in the Speyer School. The nearest approach to such a change in intellectual classification is in the case of a 14-year-old child who lost 18 points in IQ. This loss shifted him from the category of 'normal' to that of 'borderline'; that is, from an IQ of 95 to an IQ of 77, and this shift took place under the 'experience curriculum.' A comparison of the first and second test records for this case shows that practically the same test items were passed and failed on the two tests. The child with the speech defect who gained 25 IQ points changed in the intelligence classification from 'feeble-minded' to 'dull-normal'; that is, from IQ 63 to IQ 88.

V. INTERPRETATIONS AND CONCLUSIONS

Since we have been unable to confirm the findings of Wellman, the question arises whether the Speyer School has failed to provide a sufficiently 'unusual' and stimulating environment. Simpson (4) has pointed out that the more likely explanation is to be found in the fallacies that entered into the Wellman studies. For example, the children reported by Wellman whom she considers to be "not atypical," in one instance, were 33 retest cases that were the remaining fraction of an original group of 647, or about 5 percent of the group who took the first test. Herman (5) found that 67, or 15 percent, of 437 cases, all of whom had been given a retest, showed changes in IQ in excess of 10 points. As Simpson explains, the apparent changes in intelligence of such unusual magnitude shown by this remaining 5 percent might be accounted for by the factor of selection alone. Children who leave a situation are almost always selected by some factor that is absent or differs in those who remain.

Thus, the results at the Speyer School of the retests of intelligence on the Stanford-Revision of the Binet-Simon Scale indicate that a school curriculum most carefully planned and controlled to meet the present needs of one group of intellectual deviates, the dull-normal, fails to alter significantly their intellectual pattern. If one had at his command equally refined instruments by which the changes in degree of personal satisfaction and adjustment could be ascertained, the results might be very different.

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CHAPTER XVII

THE EFFECT OF A CHANGE TO A RELATIVELY SUPERIOR ENVIRONMENT UPON THE IQ'S OF ONE HUNDRED CHILDREN

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The problem of the relative constancy of the IQ has been given much attention. The literature reveals conflicting evidence, as may be noted in recent extensive reviews of the subject by Baker (1), Brooks (2), Crissey (3, 4), Dawson (5), Dearborn (6), and Foran (7). Representative of one trend of investigation are the works of Hawk (9), Skeels (15), Skeels and Fillmore (16), and Wellman (19, 20, 21, 22), all of whom report changes in IQ associated with various environmental factors. Hawk reported that training in speech results in an improvement that raises the quantitative intellectual responses of some children suffering from speech handicaps. Skeels and Fillmore report a retarding effect on mental development of poor homes that provide a minimum of mental stimulation. Crissey, studying children in different types of institutions, concluded that "the average [mental level of the environment] tends to set the 'stimulation level' for the group, and children develop as the environment demands development" (3, p. 220).

Wellman (21) from her work on mental growth has concluded that "any theory of intelligence which does not allow for the possibility, but not necessarily the fact, of extreme flexibility during the childhood period must be considered incomplete and definitely misleading . . ." (p. 138).

On the other hand, Lorge and Hollingworth (12) report high stability in the intellectual status of highly intelligent children, and

Lamson (11) could find no change in IQ attendant upon participation in a rich and vital school curriculum, saying:

Whatever the number of years over which the growth was studied; whatever the number of cases in the several groups used for comparisons; whatever the grade groups in which the IQ's were obtained; whatever the length of the interval between initial and final testing; in short, whatever the comparison, no significant change in IQ's has been found. (p. 70)

With these studies and articles like that of Garrett (8) emphasizing the controversial nature of the issue, it was decided to investigate this question at Mooseheart. The purpose of the present investigation, therefore, is to determine the effect of a change to a relatively superior environment upon the mental development of the average, normal, healthy child.

I. THE MOOSEHEART ENVIRONMENT

The environment of Mooseheart is superior to that of the homes from which most of the resident children come.

This is most obvious from a purely physical standpoint, for every effort is made to see that the *health* of all children is as perfect as can be maintained. Regular physical examinations, a regular program of preventive medicine, carefully controlled diets, and sufficient clothing are all part of a carefully followed system.¹

The *recreational environment* is also above the average. Indoor and outdoor sports together with extramural competition are freely enjoyed under the supervision of specially trained recreational directors. Motion pictures, plays, speakers from the outside, dances, and similar activities are all a regular part of this aspect of the environment. There is also free time for wandering about over the 1,200 acre tract of land, which includes a lake and woodland areas as well as a modernly operated farm.

Slightly less obvious, but just as systematically cared for, are the social, educational, vocational, and religious aspects of the environment. The *living quarters* are small cottages, each containing not more than 14 children living with a housemother and a cook and, in the case of the older boys, also a housefather. The cooking for each cottage is done in the kitchen of that cottage, so that each is a complete unit in which the customary home activities

¹ Mooseheart was founded in 1913 by Honorable James J. Davis, United States Senator from Pennsylvania. It is owned and operated by the Loyal Order of Moose as a home and school for dependent children of deceased members of the Order.

are carried on. Each child has certain responsibilities and participates in regular home duties. The children are free to receive visitors and frequently intercottage parties are arranged.

Mooseheart maintains a complete *educational system* from nursery school through high school. The academic standards of this system are nationally recognized as being excellent, and the schools are annually approved by the proper crediting agencies. In regard to educational facilities, then, the Mooseheart environment should be at least as stimulating as is to be found in the average school system.

Perhaps the most unusual aspect of the environment, however, is the *vocational training* offered. During the seventh, eighth, and ninth grades every child spends 3 months at each of several vocations, at the end of which time he or she is expected to specialize in one of them. These vocations include ornamental concrete work, sheet metal work, printing, farming, and machine shop for boys, and beauty-parlor instruction, secretarial training, cooking, and so forth for the girls. The result is that by the time each child is graduated from Mooseheart, he or she should be fully capable of earning a living in some particular line of work. This unique system of education has been in existence at Mooseheart for over 25 years.

An extra feature of the Mooseheart environment is liberal *religious and moral training* both in school and home under the direction of two resident chaplains.

The *Mooseheart Laboratory for Child Research* (Reymert, 13) maintains a clinic that systematically follows each child during his stay in an attempt to help him over any personality or educational difficulties that might hinder his living up to the highest possible level of achievement.

The *IQ distribution* at Mooseheart is the same as is found in any normal community, and Thomson (18) has shown that the personality development of these children is no different from that of children living in their own homes.¹ The IQ distribution within each cottage group ranges from low to superior, thereby giving stimulation to the children of lower IQ's in the cottage. Stimulation for children of higher IQ's is provided for by individual attention in the flexible school system.

The *ratio of adults to children* in the population has been mentioned as a factor in determining a stimulating environment. At the present time, Mooseheart has a ratio of one adult to 1.8 children, which is probably higher than in the average private home.

¹Based on his P.Q. (personality quotient) investigation at Mooseheart, Thomson states "there is no statistically significant difference which would indicate that the Mooseheart environment is more restrictive in nature than the average home environment."

In summary, it should be noted that Mooseheart is not an orphanage, for all children under 14 years of age in a family are admitted along with the mother, who is given a position in accordance with her training until the youngest child is graduated. The entrance requirements provide that no crippled or feebleminded children shall be admitted. Mooseheart has been referred to by certain state legislatures as 'a model institution.' It is typical of the spirit and interest of the Administration that Mooseheart is designated as "The City of Childhood." With its student bank, Government post office, department stores, power plant, and fire department, it has all the features of a well-rounded small community.

II. SUBJECTS AND MATERIAL

The student population of Mooseheart is ordinarily 1,000 children, coming from all states of the Union and a few from Canada, equally divided as to sex and normally distributed as to age, varying from infancy to 18½ years (at graduation). From this population, 100 children were selected at random as subjects. At the time of entrance to Mooseheart, the older form of the Stanford-Binet Test had been administered to each child and repeated annually by a group of 6 well-trained examiners, so that at the time of the study, each child had received 5 tests at intervals of one year. The mean IQ of the group at entrance was 95.80, which would be an average group according to Terman's classification (17). Since it was demonstrated by Reymert (14) that the IQ's of behavior-problem children are more variable than those of normal children, no subjects of this type were included. All were physically well. It should be noted here that out of this group, those children who entered Mooseheart after the age of 6 had had no nursery or kindergarten training in their local communities; upon arrival at Mooseheart they were, of course, placed in their appropriate grade on the basis of achievement tests and their former school record. Those children who entered at any time before the age of 6 had all had the benefit of varying degrees of nursery and kindergarten training at Mooseheart.

The age range of the subjects at the time of the first testing—that is, at the time of entrance to Mooseheart—was as follows:

<i>Chronolog- ical Age</i>	<i>Num- ber</i>	<i>Chronolog- ical Age</i>	<i>Num- ber</i>
3	7	9	13
4	7	10	9
5	7	11	11
6	9	12	5
7	14	13	4
8	13	14	1

III. PARENTAL BACKGROUND

The occupational status of the fathers of the children who served as subjects was scored according to the classification of employed males in the United States as given in the report of the 14th Census of the United States (Volume IV, 1920). This report classifies occupations in seven groups, grading downward from I to VII:

<i>Group</i>	<i>Occupation</i>
I	Professional
II	Semiprofessional and Managerial
III	Clerical, Skilled Trades and Retail Business
IV	Farmers
V	Semiskilled, Minor Positions, Minor Business
VI	Slightly Skilled Trades, and other occupations requiring little training or ability
VII	Day Laborers of all Classes

On such a classification of occupations, the fathers of this group fell into the following distribution:

<i>Group</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>	<i>V</i>	<i>VI</i>	<i>VII</i>
Percentage	0	2.0	30.0	6.0	0	20.0	42.0

The median occupational status of the group was placed at Group VI, obviously indicating that the economic level of the fathers of these children was not high.

The educational level of the mothers showed the following percentage distribution (owing to incomplete records it was not possible to obtain this same information about the fathers):

<i>School Grade</i>	<i>III</i>	<i>IV</i>	<i>V</i>	<i>VI</i>	<i>VII</i>	<i>VIII</i>	<i>IX</i>	<i>X</i>	<i>XI</i>	<i>XII</i>
Percentage	5.0	0	0	15.0	4.0	65.0	0	3.0	5.0	3.0

The median educational level of the group was placed at Grade VIII. This, coupled with the fact that 65 percent of the mothers had but a grade-school education, shows that the educational level of the group was not high, but probably equals the average for the country.

A sociological survey showed that 80 per cent of the original homes were in towns with a population under 50,000.

IV. RESULTS

Critical ratios were obtained, for the entire group of subjects, between the entrance year and each succeeding year in order to determine the general effect of the Mooseheart environment. These are shown in the following tabulation:

<i>Test</i>	<i>Num- ber</i>	<i>Mean</i>	<i>S. D.</i>	<i>Critical Ratio of Difference</i>
First	100	95.80	14.45	...
Second	100	96.75	14.85	1.44
Third	100	96.75	14.10	1.50
Fourth	100	96.10	14.95	.44
Fifth	100	96.30	14.45	.77

These results show that, as far as the group as a whole is concerned, there is no significant difference between its average IQ at entrance to Mooseheart and its average after 4 years' stay in this environment. This is made more evident by the fact that the critical ratio between the mean entrance score and the mean 4-year score is less than that between the average IQ at entrance and the average IQ at the end of the first year. When the mean entrance score was compared with the average for all four succeeding years, a gain of .68 points was obtained.

At the time of the first meeting the subjects were arbitrarily divided into age groups, one group consisting of those children of 6 years of age and under; a second group, those of 7, 8, and 9 years; and a third group, of those 10 to 14 years, inclusive. Critical ratios were then determined between the entrance year and each succeeding year for all groups (Table I).

TABLE I.—DIVISION OF IQ'S INTO THREE AGE GROUPS, SHOWING MEANS, STANDARD DEVIATIONS, AND CRITICAL RATIOS OF DIFFERENCE BETWEEN ENTRANCE TEST AND EACH SUCCEEDING TEST

<i>Test</i>	<i>Mean</i>	<i>Stand- ard De- viation</i>	<i>Crit. Ratio of Diff.</i>
30 Children 6 Years Old and Under			
1st test (entrance)	96.66	14.07	...
2nd test	102.00	14.83	4.48
3rd test	104.80	11.67	7.20
4th test	101.80	12.36	4.58
5th test	103.25	9.46	5.23
40 Children 7, 8, and 9 Years Old			
1st test (entrance)	96.32	12.32	..
2nd test	97.00	13.52	.74
3rd test	96.85	14.93	.51
4th test	95.46	13.14	.94
5th test	97.00	11.60	.80
30 Children 10 to 14 Years Old			
1st test (entrance)	92.00	12.32	..
2nd test	92.21	12.36	.20
3rd test	91.66	12.95	.32
4th test	91.06	13.66	.86
5th test	91.65	11.40	.35

Both individual and collective scores of this distribution indicate, we find, a significant increase in IQ only in the cases of young children; that is, those 6 years of age and under.¹ There was, moreover, no one

¹ Because of the fact that there were 8 children in the third group (10 to 14 years) whose IQ's were all well below 90 and 4 children whose IQ's were well above 110, the average IQ of this group at entrance was lower than that of the other groups. The standard deviation, however, of this group is approximately the same as that of the others. While, as may be seen, there is a 4.66 difference between the mean IQ of the group of children who were 6 years and under and those who were 7, 8, and 9 years, and 4.3 difference between the children 7, 8, and 9 years and those between 10 to 14 years, these differences are not statistically significant.

child among the younger group who showed an unusually large IQ advancement—the greatest increase from one year to another was but 11 points—nor were there any more children of superior mental ability in this group than in either of the other two. The average improvement in test score over the four-year period was 6.15 points, as compared to a gain of .26 points for subjects 6 years and under, and a loss of .36 points for the children 10 to 14 years old.

TABLE II.—DIVISION OF CHILDREN INTO TWO GROUPS ON THE BASIS OF IQ RANGES AT TIME OF ENTRANCE, SHOWING MEAN IQ, STANDARD DEVIATION, AND CRITICAL RATIOS OF DIFFERENCE BETWEEN ENTRANCE TEST AND EACH SUCCEEDING TEST

<i>Test</i>	<i>Mean</i>	<i>Stand- ard De- viation</i>	<i>Crit. Ratio of Diff.</i>
49 Children, 70 to 94 IQ			
1st test (entrance)	84.95	7.30	...
2nd test	84.70	7.95	.50
3rd test	84.75	7.70	.41
4th test	84.60	7.95	.70
5th test	84.10	5.35	1.77
51 Children, 95 to 130 IQ			
1st test (entrance)	105.55	8.35	...
2nd test	106.05	9.00	.91
3rd test	106.45	9.40	1.61
4th test	106.20	7.90	1.31
5th test	106.40	6.60	1.61

The IQ distribution at entrance was arbitrarily divided into two sections: those IQ's that ranged from 70 to 94 in one class, and those that ranged from 95 to 130 in another. Again, the entrance scores of each group were compared to those of the following years.

The critical ratios of Table II show that there is a tendency for high-normal or superior children to exhibit a slightly greater increase in IQ. This is evidenced by the fact that subjects of this group gained an average .72 point in IQ during the 4-year period, while subjects

of the other group lost an average of .41 point in IQ during the same length of time. It was further noticed that the superior children exhibited the same constancy of intellectual development that Hollingworth (10) mentions.

As a further means of differentiation, the children were classified according to the monthly incomes of their fathers. This resulted in three income groups, the first from 0 to \$75.00 per month, the second from \$76.00 to \$150.00 per month, and the third from \$151.00 to \$225.00 per month (Table III).

On inspection of this classification, we again see no significant rise in IQ. As a matter of fact, the differences were even less significant than in former distributions. The first two groups, however, did show an average gain in IQ of .66 point and .56 point, respectively, over the four-year period, whereas the third group lost an average of .24 points. In addition, no significant difference was found between the entrance and yearly scores of one group when compared with the entrance and yearly scores of another group.

When the subjects were distributed according to the amount of time that had elapsed between the deaths of their fathers and their entrance to Mooseheart, three groups resulted—the first from 0 to 12 months, the second from 13 to 24 months, and the third 25 or more months. All three groups showed an average IQ increase over the 4-year period, yet none was enough to be a significant change. The first group exhibited an average gain in IQ of .79 point during 4 years; the second, of .53 point; the third, of .92 point. There was, moreover, no significant difference to be found between the entrance and yearly scores of one group when compared to entrance and yearly scores of another group.

Again, the children were classified according to the type of schooling they had received before entrance to Mooseheart. Those who had attended school, or kindergarten, or preschool regularly were placed in one group; those who had attended irregularly, in a second group. In each of these groups, as in the case of all others, the average IQ at entrance was compared statistically with the average IQ for each succeeding year.

In this classification 'irregular schooling' means that a child has been out of school for short periods, off and on, for more than a year

TABLE III.—CLASSIFICATION OF CHILDREN INTO THREE GROUPS ACCORDING TO AMOUNT OF MONTHLY INCOME OF FATHERS, SHOWN WITH CRITICAL RATIOS OF DIFFERENCE BETWEEN ENTRANCE TEST AND EACH SUCCEEDING TEST

<i>Test</i>	<i>Mean</i>	<i>Stand- ard De- viation</i>	<i>Crit. Ratio of Diff.</i>
Income, 0 to \$75: 30 Cases			
1st test (entrance)	95.28	12.90	..
2nd test	95.35	16.73	.05
3rd test	96.21	17.11	.65
4th test	96.00	15.93	.56
5th test	96.20	13.96	.82
Income, \$76 to \$150: 40 Cases			
1st test (entrance)	96.90	13.10	..
2nd test	97.55	15.35	.61
3rd test	97.15	14.85	.28
4th test	97.35	15.25	.43
5th test	97.80	14.50	.91
Income, \$150 to \$225: 30 Cases			
1st test (entrance)	95.00	13.51	..
2nd test	96.64	14.22	.31
3rd test	94.42	14.85	.48
4th test	95.00	14.03	.00
5th test	95.00	14.58	.00

or has had more than one year out of school in his record. Most cases showed the first condition.

The economic background of the children in the regular attendance group was superior, on the whole, to that of the children in the irregular attendance group. The occupational status of parents and the educational level reached by the mothers bear this out:

<i>Occupational Group</i>	<i>Percentage of Fathers in Each Classification</i>	
	<i>Regular School Attendance</i>	<i>Irregular School Attendance</i>
I	0	0
II	5.0	0
III	38.0	12.5
IV	10.0	5.0
V	0	0
VI	25.0	12.5
VII	22.0	70.0

It is readily seen that the median occupational level of the fathers of children who attended school regularly would be at Level IV, while that of the fathers of the children who attended school irregularly would be at Level VII.

TABLE IV.—CLASSIFICATION OF CHILDREN ACCORDING TO AMOUNT OF SCHOOLING RECEIVED BEFORE ENTRANCE TO MOOSEHEART, SHOWING MEAN IQ'S, STANDARD DEVIATIONS, AND CRITICAL RATIOS OF DIFFERENCE BETWEEN ENTRANCE TEST AND EACH SUCCEEDING TEST

<i>Test</i>	<i>Mean</i>	<i>Stand- ard De- viation</i>	<i>Crit. Ratio of Diff.</i>
Regular Attendance at School: 40 Children			
1st test (entrance)	98.10	10.30	...
2nd test	98.60	11.45	.63
3rd test	98.80	12.10	.83
4th test	98.95	11.65	1.06
5th test	99.00	10.70	1.50
Irregular Attendance at School: 40 Children			
1st test (entrance)	86.00	12.05	...
2nd test	86.35	11.60	.41
3rd test	86.65	13.40	.72
4th test	87.50	14.50	1.48
5th test	87.00	14.45	.99

Similarly, the educational level of the mothers of those who attended school regularly was higher (90 percent of them reaching eighth grade or higher) than was the educational level of the mothers of those who attended school irregularly (only 57 percent of these reaching the eighth grade).

The difference in average IQ at entrance between the two groups seems to denote the difference in the socio-economic status of the parents of the two groups. The point to be noted in Table IV, however, is that, once these environmental factors had been improved, the average IQ of the group attending irregularly did not change significantly, which also corresponds with the findings of Lamson (11).

V. SUMMARY

1. In order to test the effect of a relatively superior environment on the IQ's of children, the case histories of 100 children at Mooseheart were examined. The age range at the time of entrance to Mooseheart was from 3 to 14 years, and the IQ range from 70 to 130. All were physically well and had been in the superior environment of Mooseheart for 4 years. Each child had been given the old form of the Stanford-Binet test at entrance and had been examined yearly with the same test.

2. That the environment of Mooseheart is superior to most of the homes from which the subjects came was shown by a sociological survey of parents' employment and education. The average male parent belonged to the "slightly skilled trades and other occupations requiring little training or ability," though 42 percent were day laborers. The median educational level of the mothers was Grade VIII. A comparison of the Mooseheart environment with the environment provided by the parents showed the former to be vastly superior in all respects.

3. A comparison of the entrance-test scores of the whole group with those of each succeeding year showed no significant gain in IQ, even after 4 years' stay in the environment.

4. By dividing the subjects into age levels, it was found that children of 6 years and under, both individually and as a group, showed a significant gain in IQ after one year's residence at Mooseheart. Small but significant gains continued throughout the four years' testing period for this group. The other age groups—one consisting of children

of 7, 8, and 9 years, and the other of children from 10 to 14 years—showed no significant gain.

5. By dividing the subjects according to IQ, with one group ranging from 70 to 94, and the other from 95 to 130, it was found that change to the relatively superior environment of Mooseheart did not cause a significant rise in IQ in children whose mental ability is either above or below the normal limits.

6. The subjects were further compared from the points of view of economic background of parents, length of time that had elapsed between death of father and entrance to Mooseheart, and regularity of previous schooling. None of these classifications showed a significant gain in IQ over entrance score.

VI. CONCLUSIONS

Indications from our study, then, seem to be that if the removal of children from a relatively inferior to a relatively superior environment is to have an advantageous effect on their IQ's, such change should be made before they reach the age of 6, because, for children from school-entrance age on, the IQ remained constant over 5 annual examinations following upon a change to a relatively superior environment.

It should be noted in interpreting these results that the preschool group, which showed a significant rise in IQ, had all had some measure of nursery and kindergarten training whereas the older group had had no such training. Might it not be, then, that the rise in IQ of the preschool group is due in considerable measure to the fact that the solving of several of the items in the preschool range of the scale depends upon specific information (such as, sex, last name, parts of body, and so forth) and that such information is being gradually supplied in nursery and kindergarten training?

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CHAPTER XVIII

THE INTELLIGENCE OF SCOTTISH CHILDREN

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I. THE 1932 SCOTTISH SURVEY

In 1932 the Scottish Council for Research in Education undertook a mental survey of a complete age group; namely, all pupils in Scotland born in 1921. All pupils 11 years of age in the public schools, no matter in what grade they chanced to be, all the children attending private schools (with a very few negligible exceptions), and all children housed in institutions were included. The group was as complete as could be expected, comprising in all 87,498 pupils. The test applied was a group test of the usual verbal types, but a set of pictorial-classification items was included for the benefit of the weaker pupils. The distributions obtained from the results gave a standard deviation of 17 for boys, and 16 for girls. To calibrate the group test and enable IQ's to be computed, it was deemed advisable to test a random sample with an individual test; a thousand of the pupils whose scores on the group test were available were consequently tested with the 1916 Stanford Revision of the Binet Test; to satisfy the requirements of a random sample, these pupils, referred to usually as 'the Binet Thousand,' were selected from those born on June 1, 1921, or as near thereto as possible, and were representative of the different geographical areas. In spite of the precautions observed, the Binet Thousand proved to be a superior sample, as a comparison of their group scores with the general distribution showed, the reason being that only voluntary testers were available for this work, and they naturally tested the pupils in the schools to which they had the readiest access. It was nevertheless possible, by making due allowance for the superiority of

the Binet Thousand, to infer the mean IQ for the Scottish pupils on the group test.¹

II. THE 1935-1937 SURVEY

In spite of this achievement, the Scottish International Examination Inquiry Committee, which had adopted the intelligence testing program of the Research Council, was still desirous of securing for individual testing a more truly representative sample of Scottish pupils than the Binet Thousand to correct and supplement the 1932 Survey. A proposal to this effect was put to the International Inquiry on School and University Examinations at its Folkestone Conference in 1935, and the necessary subsidy was granted.² To secure such an unbiased sample as could be individually tested by one tester within a reasonable time, it was decided to test all children in Scotland born on February 1, May 1, August 1, and November 1 in the year 1926. It was expected that this would produce a sample of about 1,000 children, but the group actually numbered 874, of whom 444 were boys and 430 girls. All were tested, no matter how remotely located, with the exception of one—a boy of the Irish laboring class, who with his family disappeared completely from a slum area in Glasgow. It is doubtful whether a more perfect sample could anywhere else be secured. The testing occupied 2 years and 3 months, from September, 1935, to November, 1937, inclusive. The age range of the tested pupils, calculated on the basis of the date of testing, was found to be 2 years, 9 months—from 8 years, 11 months, to 11 years, 8 months. The test used was again the 1916 Stanford Revision with very slight modifications to suit Scottish conditions. A battery of performance tests was also applied, and for the performance testing an additional tester was employed.

III. COMPARISON OF THE TWO SURVEYS

A comparison of the results of this test with those of the 1932 Survey is seen in the tabulations on the following page.

¹ *The Intelligence of Scottish Children: A National Survey of an Age-Group.* (Publications of the Scottish Council for Research in Education, No. 5. University of London Press Ltd.: London, 1933) 160 pp. (Esp. pp. 91-102.)

² *Conference on Examinations, II.* [Proceedings, edited by P. Monroe] (Bureau of Publications, Teachers College, Columbia University: New York, 1936) 300 pp.

Before considering sex and other differences, we should like to point out that an intelligence test is one of the least satisfactory instruments for diagnosing sex differences, environmental influences, and the like, since in the construction of an intelligence scale all tests displaying significant sex differences are rejected. If sex differences are revealed by the application of such a scale to a truly representative sample, the conclusion to be drawn is that the rejection of the sex-biased items has not been sufficiently thorough; we are merely criticising or condemning the scale; similarly with environmental influ-

	1932 Survey		1935-1937 Survey		
	Group Test		Stanford-Binet Revision (1916)		
	Boys	Girls	Boys	Girls	Total
Mean	103	100	100.51	99.7	100.11
σ	17	16	15.88	15.26	15.58
Number	44,210	43,288	444	430	874

	1932 Survey		1935-1937 Survey		
			Percent*		
	Boys	Girls	Boys	Girls	Total
Above 129 IQ	4	3	5.4	3.9	4.7
110 to 129	24	24	22.3	20	21.2
90 to 109	44	46	46.2	51.2	48.6
70 to 89	24	24	25.5	23.0	24.2
Below 70 IQ	4	3	0.7	1.9	1.3

* Calculated from the standard deviation.

ences, including social conditions. Intelligence tests are designed to determine innate differences in intelligence; items demanding acquired knowledge, or affected by environmental influences, should be excluded. The greater the effect of environmental influences revealed by tests, the poorer, consequently, is the scale. A perfect intelligence scale would *ex hypothesi* reveal neither sex differences nor environmental influences. Instead of using intelligence tests to determine these, we should rather employ the sex differences and environmental influences that are revealed to check the tests.

IV. THE AVERAGE INTELLIGENCE QUOTIENT

The data of the 1932 Group Survey suggested that the average IQ of Scottish boys born in 1921 was very close to 100, and that the average IQ of girls might be somewhat less, but the conclusion reached was that there was no proof of a significant difference between boys and girls in average IQ.¹ The difference of 0.8 point of IQ between the mean for boys and the mean for girls in the later Individual Survey of 1935-1937 is not statistically significant. The difference of the standard deviation of the verbal score in the 1932 Group Test was 15.93 ± 0.04 and 15.02 ± 0.03 ; that is, 0.91 ± 0.05 , which is clearly significant, whereas the difference of 0.6 point of IQ of standard deviation in the 1935-1937 Individual Test is not statistically significant.

V. RURAL AND URBAN AREAS

The Scottish results, both in the Group Survey and in the Individual Survey, do not support the generally accepted belief that there are marked differences in distribution of intelligence in rural and urban areas. In the Group Survey the percentage of pupils from rural or sparsely populated areas with low scores did not differ significantly from that of pupils in urban or densely populated areas, and the same conclusion held for pupils with high scores.² The Individual Survey reinforces this conclusion. Scotland may be divided into the four cities, the industrial belt, and the rural areas; a subdivision of the rural areas comprising the Highlands and Islands was isolated to secure a more truly rural group. The results are:

	<i>N</i>	<i>Mean</i>	<i>σ</i>
The Four Cities	319	100.86	15.29
The Industrial Belt	393	99.19	16.18
The Rural Areas	162	100.92	14.52
(Included in Rural Areas— Highlands and Islands)	47	101.79	13.13

There are no statistically significant differences, but it is interesting that the mean of the most remote and isolated districts is the

¹ *The Intelligence of Scottish Children*, p. 102.

² *The Year Book of Education*. [Edited by E. Percy, P. Nunn, & D. Wilson] (Evans Bros. Ltd.: London, 1935) 962 pp. (Esp. pp. 466-467.)

highest and its standard deviation the lowest. It may be worth mentioning in this connection that perhaps nowhere has scholastic opportunity been more evenly equated than in Scotland; 99.7 percent of Scottish teachers are fully trained.

VI. THE MONTH OF BIRTH

The data of the Individual Survey invited consideration from a standpoint not contemplated in the 1932 Group Survey, but raised later by Pintner and Forlando.¹ The Scottish results viewed from this standpoint show:

	<i>February</i>	<i>May</i>	<i>August</i>	<i>November</i>
Mean	96.6	99.43	101.25	100.35
σ	14.56	15.13	16.46	15.88
Number	218	253	206	197

Again no statistically significant differences are found, but August children do tend to be brighter than those born in May or February. This agrees with the finding of Pintner and Forlando, who found that there was no seasonal change in intelligence of any significance, but that winter months are definitely associated with lower means of intelligence.

VII. THE FORM OF THE DISTRIBUTION

To postulate that intelligence-test results should conform to normal frequency is to assume that intelligence is a complex of innumerable independent traits, but if intelligence tested by intelligence tests is, in significant measure, a cultural product, it is highly doubtful whether we should expect it to be normally distributed. In the 1932 Scottish Survey there was very little evidence to offer in proof of either symmetry or Gaussian distribution. In the Individual Survey of 1935-1937 the distribution of intelligence in the total group is not normal, and the divergence from normality can by no means be attributed to 'chance' or fluctuations of sampling, and this also holds for boys and girls separately.

The Individual Survey summarized above is now available.²

¹ R. Pintner and G. Forlando. "The influence of month of birth on intelligence quotients." *Jour. Educ. Psychol.*, 24: 1933, 561-584.

² A. M. Macmeecken. *The Intelligence of a Representative Group of Scottish Children*. (Publications of the Scottish Council for Research in Education, No. 15. Univ. of London Press, Ltd.; London, 1939) 144 pp.

CHAPTER XIX
THE CUMULATIVE INFLUENCE ON INTELLIGENCE OF
SOCIO-ECONOMIC DIFFERENTIALS OPERATING ON
THE SAME CHILDREN OVER A PERIOD
OF TEN YEARS

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There is abundant evidence that the socio-economic status of children is associated with their intelligence, but little agreement as to the interpretation of this association. One way of throwing light on the problem would be to determine whether the association becomes stronger with increasing age, on the theory that environmental factors, if actually potent, should show greater effects, the longer they operate. Kelley¹ was the first to present a clear formulation of this principle. Wheeler's² study of the average intelligence of children reared in the impoverished environment of the mountains of eastern Tennessee provides a good illustration. These children tested approximately normal at age 6, but average IQ's fell markedly with later age groups. Bayley and Jones³ were the first to employ repeated measurements of the same children in studying this problem. They report a correlation of .12 at 18 months between education of mother and the child's IQ as measured by the California Preschool Scale I. At 21 months the correlation was .37; at 24 months, .52; thereafter, up to 60 months the correlations fluctuated from .40 to .50. It is not easy to interpret these findings, since we cannot be certain that the test employed gives equally valid measures of intelligence from 18 to 60 months. The number of cases is small and varies from 37 to 46 at

¹T. L. Kelley. *The Influences of Nature on Native Differences*. (Macmillan: New York, 1926) pp. 49. (especially p. 16).

²L. R. Wheeler. "The intelligence of East Tennessee mountain children." *Jour. Educ. Psychol.*, 23: 1932, 351-370.

³N. Bayley and H. E. Jones. "Environmental correlates of mental and motor development: A cumulative study from infancy to six years." *Child Develop.*, 8: 1937, 329-341.

different age levels. If it is assumed that environmental differences are potent in creating IQ differences, it would be desirable to determine why these effects are so conspicuous from 18 to 24 months, and why there is so little further accumulation of effect afterward.

In a further study of this problem the writer has employed mental test data collected by the Harvard Growth Study.

Beginning in the second grade of one city and in the third grade of two cities near Boston, the Harvard study was planned to give two group intelligence tests every year to the same children as long as they remained in school. These data on 1,553 cases, each with approximately 9 annual measurements by two group intelligence tests, have been published *in extenso*.¹ Fourteen different tests or test forms were employed, some only once, some as many as four times. In connection with other studies, the reported mental ages were translated into IQ's by dividing by 162, 172, 181, 188, 192, 195, and 196 months, respectively, at chronological ages 13.5, 14.5, 15.5, 16.5, 17.5, 18.5 and 19.5 years and by using appropriate divisors at intervening points. The pairs of IQ's obtained from each annual testing were averaged. Only records with uniform data were selected so as to hold constant specific practice effects incident to the repetition of certain tests. The resulting average IQ's from the two tests given in the second grade were distributed for all available cases of both sexes. Similar distributions were prepared for the average IQ's obtained from testing the same children in the third grade, in the fourth grade, and so on through the twelfth grade, or twelfth year of the Harvard Study. The means and standard deviations of these 11 distributions differ considerably because different tests were involved from year to year. Hence, the data for each school grade were adjusted to give average IQ's of 100 with standard deviations of 14.6 points.

In appraising these data, it must be noted that they were never used in any practical way at the time they were collected; hence, it is probable that the children were not as adequately or uniformly motivated as might be desired. But it must also be noted that each datum of this study is based on two tests, that the IQ's have been adjusted to correct for differences in test standardizations, and that repeated annual measurements over a period of 10 years are available. The individual records, however, are far from regular and few are complete.

Since, in the analysis of the physical measurements collected by the Harvard study, I consistently edited the data for erratic measurements and

¹ W. F. Dearborn, J. W. M. Rothney, and F. K. Shuttleworth. *Data on the Growth of Public School Children from the Materials of the Harvard Growth Study*. (Washington, D. C., National Research Council, 1938) p. 136. Is also Vol. III., No. 1, Monographs Society for Research in Child Development.

filled gaps in the data by interpolation,¹ it may be well to say that these two procedures have not been employed in the analysis of the mental test data.

For the purpose of this study I selected 398 boys of North European stock for whom data concerning father's occupational level on a five-point scale are available. From this group a further selection of 53 cases from the first and second levels (professional, semiprofessional, managerial, and large business), and of 131 cases from the fourth and fifth levels (semiskilled and unskilled labor) has been made for intensive study.

It is at this point that the available data are least adequate. The occupational data were collected during the first year of the Harvard study and were neither rechecked at a later date nor supplemented by other data. Those who know the three communities involved report that there was little shifting of occupational levels during the first ten years of the Harvard study to 1932, but that, thereafter, some indefinite proportion of these in semiprofessional and managerial positions were unemployed. Possibly if a classification by occupational level were available for 1934, the twelfth year of the Harvard study, our selection of cases would not be very materially altered.

But these considerations are not strictly relevant. Our problem requires the selection of two groups of cases constantly subjected over a period of ten years to mildly stimulating and to mildly repressing intellectual environments. The actual selection of cases can only be described as a very rough approximation to this ideal.

In the analysis of the data two statistical procedures, developed in working with repeated physical measurements, have been employed.²

First, the analysis of the two contrasted groups has been carried out separately for cases measured approximately at birthdays and for cases measured approximately at the half-yearly anniversaries of birthdays. This is an unimportant detail in the present study. When two such groups are combined, it merely provides observation points at half-yearly intervals, although the original measurements were made at annual intervals.

Second, and this is believed to be important, the analysis has been carried out by averaging IQ's for identical cases from age to age rather than by averaging available IQ's at each age. For example, assume six cases with constant IQ's of 105, 103, 101, 99, 97, and 95

¹F. K. Shuttleworth. *Sexual Maturation and the Physical Growth of Girls Age Six to Nineteen*. (Washington, D. C., National Research Council, 1937) 252 pp. Vol. II, No. 5, Monographs of Society for Research in Child Development.

²*Ibid.*, pp. 9 to 24; 214 to 229.

and assume these cases were initially measured at ages 8, 9, 10, 11, 12, and 13, respectively. Averaging the available cases at each age (the conventional procedure), the average IQ of the cases drops from 105 at age 8 to 100 at age 13, a result which is clearly in error. The proper procedure, when repeated measurements are available, is to compute

TABLE I.—TRENDS IN AVERAGE IQ'S OF BOYS OF NORTH EUROPEAN STOCK FROM UPPER AND LOWER OCCUPATIONAL LEVELS

Age in Years	Upper Occupation- al Levels		Lower Occupation- al Levels		Differ- ence in IQ
	Num- ber	Mean	Num- ber	Mean	
8.0	13	109.3	34	95.1	14.2
8.5	19	109.2	50	96.0	13.2
9.0	27	108.7	72	97.8	11.5
9.5	36	108.6	91	98.0	10.6
10.0	46	108.9	91	97.8	11.1
10.5	47	108.6	99	97.1	11.5
11.0	47	107.5	99	96.6	10.9
11.5	46	107.5	99	96.6	10.9
12.0	45	108.0	99	96.8	11.2
12.5	45	107.8	99	97.2	10.6
13.0	45	107.4	99	97.5	9.9
13.5	46	107.3	99	97.4	9.9
14.0	47	107.8	105	97.1	10.7
14.5	48	108.1	105	97.4	10.7
15.0	48	107.2	108	95.8	11.4
15.5	44	105.9	108	95.6	10.3
16.0	44	105.9	108	95.5	10.4
16.5	42	106.5	108	95.6	10.9
17.0	39	105.9	94	95.6	10.3
17.5	24	106.3	71	95.2	11.1
18.0	11	108.3	33	95.4	12.9

a single average at the age where the most cases are available, to determine trends based on identical cases from age to age, and to add or subtract these trends from the initially determined average.¹

Table I presents the findings. The ages at the left are midpoints of intervals of six months. Although 53 boys from the upper occu-

¹ See Shuttleworth, *op. cit.*

pational levels are involved, incomplete data and the method of analysis by identical cases from age to age combine to reduce the usable observations. As already indicated, the means are not conventional averages. A single average has been computed for each group at age 15.0, and trends from these points have been determined. Thus, the trend from average IQ of 109.3 at age 8.0 to 109.2 at age of 8.5 shown by boys from the upper occupational levels was determined by 13 cases measured at ages 8.0 and 9.0; the trend from the age 8.5 to 9.0 was determined by these same cases plus an additional 6 cases measured at ages 8.5 and 9.5. There is a surprisingly large difference in the mean IQ's of the two groups, ranging, as indicated in the extreme right-hand column, from 9.9 to 14.2 IQ points. We are not interested, however, in the general size of these differences, but in the way in which these differences fluctuate with age. There is a clearly defined trend to smaller and smaller differences from age 8.0 to age 13.5, which is contrary to expectations under the theory that environmental differences should show increasing effects, the longer they operate. From age 13.5 to age 18.0 there is a slight irregular tendency for the differences to increase. It has not seemed worth while to carry out the rather elaborate study necessary to check the statistical significance of these trends. Considering the number of cases at the earliest and latest ages, it is the writer's judgment that the trends of the differences are not statistically reliable.

Clearly there is no evidence that socio-economic differences operating over a long period of years have a cumulative effect in creating progressively larger IQ differences. These results, however, fall short of providing a probable inference that mildly favorable or unfavorable intellectual stimulation operating continuously from age 8 to age 18 does not have a cumulative influence on intelligence.

Other interpretations, which must be weighed, may be listed as follows.¹ It is possible that the quality of intellectual stimulation provided by different homes changed during the 10-year interval in such a way that the environmental differences became smaller with increasing age. It is possible that the school environment operated to discourage the brighter and to stimulate the duller students, and

¹F. K. Shuttleworth. "The nature versus nurture problem. Part I. The definition of the problem. Part II. The contributions of nature and nurture to individual differences in intelligence." *Jour. Educ. Psychol.*, 26: 1935, 561-578; 655-681.

thus to cancel and reverse the expected trends. It is possible that the cumulative influence of favorable or unfavorable stimulation from parents had already spent its full force prior to age 8 in such a way that these environmental differences, while still in existence, had ceased to 'operate.' It is possible that the environmental differences existing in typical American communities account for such a relatively small proportion of the individual differences in intelligence that Kelley's thesis cannot be demonstrated in respect to intelligence save under exceptionally favorable conditions.

CHAPTER XX

SOME IOWA STUDIES OF THE MENTAL GROWTH OF
CHILDREN IN RELATION TO DIFFERENTIALS
OF THE ENVIRONMENT: A SUMMARY

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The study of the nature of intelligence challenges the interest of psychologists and educators not only because of the theoretical concepts involved but also because of the implications relating to child care and education. If, on the one hand, intelligence is static, a fixed entity, and relatively unmodifiable by changes in environmental impact, then changes in living conditions and amount and kind of education can be expected to have little influence on the mental (intelligence) level of individuals.

On the other hand, if intelligence shows change in relation to shifts in environmental influences, then our concept must include modifiability, and the implications for child welfare become more challenging.

This latter concept was postulated by Alfred Binet. In *Les Idées Modernes sur les Enfants* (1), published in 1909, Binet devotes an enlightening chapter to the topic, *Intelligence: Its Measurement and Education*. He is surprised and concerned at the prejudice against the concept of modifiability of intelligence. To quote:

Some recent philosophers appear to have given their moral support to the deplorable verdict that the intelligence of an individual is a fixed quantity, a quantity that cannot be augmented. We must protest and act against this brutal pessimism. We shall endeavor to show that it has no foundation whatsoever. (p. 141)

After discussing the teaching of subnormal children, Binet summarizes as follows:

A child's mind is like a field for which an expert farmer has advised a change in the method of cultivating, with the result that in place

of desert land, we now have a harvest. It is in this particular sense, the only one which is significant, that we say that the intelligence of children may be increased. One increases that which constitutes the intelligence of a school child; namely, the capacity to learn, to improve with instruction. (p. 146)

Several studies have been carried on by the Iowa Child Welfare Research Station during the past six years relating to this question of modifiability of intelligence in children. Trends in mental growth are dealt with here in relation to four conditions: (1) in relation to length of residence in underprivileged homes; (2) in relation to a shift from the underprivileged home environment to a superior adoptive home environment; (3) in relation to the placing of children from the lower socio-economic levels in above average and superior adoptive homes in their early infancy; and (4) in relation to the transferring of children of low intelligence from a relatively non-stimulating institutional environment to one of markedly superior stimulation value at the early preschool ages. As these studies have already been made public, only brief abstracts will be presented here.

I. MENTAL GROWTH IN RELATION TO LENGTH OF RESIDENCE IN UNDERPRIVILEGED HOMES

Familiarity with the pattern of IQ's of children in the same family when admitted to an orphanage suggested a study of this problem, which was reported by Skeels and Fillmore (14). Scanning of family records made it seem pertinent to investigate whether there was really an unusual, consistent downward trend of IQ's among the older members of a family; whether the length of stay in the type of home represented might be related to mental status as measured by the Stanford-Binet examination.

There were 132 families, each having two or more children committed to the Iowa Soldiers' Orphans' Home and examined within a few weeks after admission to the orphanage. Four hundred and seven children, ranging in age from 1 to 14 years, were used. All examinations were made by trained psychologists who had had long experience in mental testing and dealing with children in varied situations. Children under 3.5 years of age were given the Kuhlmann-Binet; those over that age, the Stanford-Binet.

Status of the parents in relation to occupation, education, institutional residence, desertion of family, and general family situation represents a definite selection from the lower levels.

For 71 families the occupation of the father was given in the history. These were rated according to the classification of occupations of employed males in the United States from the report of the *Fourteenth Census of the United States*, Volume 4, 1920.¹ Judged by this standard, 67.6 percent of the fathers were employed as day laborers, slightly skilled workmen, or in occupations requiring little training or ability. The remainder were in semi-skilled or skilled occupations, clerical positions, business, and farming. None was in the ranks of professional occupations. The 67.6 percent in the lower ranking occupations may be contrasted with the 32.2 percent of such workers in the nation as a whole. On the basis of occupational level, it might be assumed that constructive opportunities for the children had probably been limited. Such an assumption appears valid when facts enumerated later are also considered. Although the occupational status was given for only a part of the group, these families seemed to have enough characteristics in common with the others to make them a typical sample of the 132 families.

Educational status is also far from flattering. For 38 families records of both parents were given. The school-grade range of the mothers was 2 to 12, with a mean grade of 7.5. The fathers' range was 3 to 12 (with one having "college training"); their mean grade was 8. The median for each group of 38 parents was Grade VIII.

In these 132 families, of the 111 mothers living at the time the children entered the orphanage, 18, or 16.2 percent, were residents of state or county institutions, 8 were in insane hospitals, 5 in the reformatory, 2 in homes for feeble-minded, and 3 in county homes for the indigent. Of the 119 living fathers, 19, or 17.1 percent, were residing in institutions, 9 were in the penitentiary, 4 in jails, 4 in insane hospitals, and 2 in the reformatory.

In addition to the foregoing group of parents, there were 5 mothers and 18 fathers who at some time had been in institutions; 13 had been in jail, 4 in the penitentiary, 4 in insane hospitals, and 2 in the reformatory. Eleven families had been deserted by one of the parents. In 2 families both parents had left.

Although based on data for only a part of the families, it is believed that the picture given is typical of the family status of the whole group. The group appears to be homogeneous; the parents are largely in the lower occupational levels, the average educational rating of the parents is Grade VIII. While poor economic status and lack of edu-

¹ Cited by Goodenough and Anderson (7); see appendix, pp. 501-512.

cational opportunities need not necessarily be damaging, there were in these families other factors that could not be compensated for. The apparent low mentality of many parents, the poor condition of the homes, lack of parental responsibility, and the presence of insanity and law-breaking activities created an extremely impoverished home environment—homes that could provide no more than a minimum of stimulation to mental development.

Results of intelligence tests on the children show a mean level of intelligence lower than that prevailing in the population as a whole. The mean IQ of the 407 children was 88.5. When considered by age, it is seen by the accompanying tabulation that the groups that reach or exceed the mean for the whole, 88.5, are under 10 years of age.

<i>Chron. Age in Years</i>	<i>Num- ber</i>	<i>Mean IQ*</i>	<i>Chron. Age in Years</i>	<i>Num- ber</i>	<i>Mean IQ*</i>
1	8	108.4	8	35	90.7
2	27	93.3	9	51	88.7
3	22	87.7	10	34	85.4
4	20	92.6	11	37	83.3
5	42	89.7	12	35	81.6
6	24	98.0	13	17	79.6
7	37	92.2	14	18	79.9

*Children under 3.5 years of age were given the Kuhlmann Revision of the Binet. Children over 3.5 years of age received the 1916 Stanford Revision of the Binet.

Since a slight decrease in IQ for successive age groups has commonly been found, comparisons by age of children from 5 to 14 years were made with Terman's (17) 905 unselected children. While Terman's children show a slight fluctuation below their mean of 102.0 beginning with year 12, the orphanage group shows a greater one below their mean (87.5 at these ages), beginning with year 10.

Since the age of the children as used in the preceding summaries was taken as of the time of entrance to the orphanage, age therefore corresponds to the length of time spent in the child's own home. Homogeneous as this group has been shown to be in respect to family background, it is considered that the findings for age groups are one indication of the relation of IQ to length of time in the home. While

it is known that the younger children in these homes have not been in stimulating surroundings, the effect of this, as these results suggest, is a matter of time. Although there are fluctuations by age among the mean IQ's of the younger children, on the whole they maintain a higher level than do the older ones. However, after 6 years in homes of a decidedly poor character, the mean level of intelligence drops with each year for 7 years.

Since commitment of children to the orphanage is on a basis of inadequacy of the home, rather than mental level of the children, and since in general all children from a given family are committed, it is felt that this decline in mental level with increase in age is not due to a selective factor in committing only the duller children to an institution.

To investigate further the relation between length of time in the child's own home and IQ, children in the same families were paired with each other. Each child was compared with every other one in his family, and records were made of difference in age or length of time in the home and the IQ's of the older and younger members of each pair. Since the family backgrounds were homogeneous, all the data provided by these pairs of siblings were used in the various classifications.

The results of these comparisons of IQ's indicate that a difference in length of stay in the home of one year is not joined with a significant difference in IQ. When the length of stay is two years longer for the older members, then the IQ's are lower to an extent very near to complete reliability. However, when the difference is extended to 3 years, it is then reliably established that the children who have been in the home that much longer than their siblings actually have lower IQ's. With wider intervals of years' stay this difference between the older and younger children is sustained, although with not so high a certainty of significance, perhaps owing to the fewer individuals represented.

From these findings the authors conclude as follows:

1. These children came from poor backgrounds, as indicated by low economic status, limited education of parents, and conflict with law.
2. The level of intelligence of the children, 1 to 14 years of age, is shown by a mean IQ of 88.5.
3. Children under 8 years of age are of a higher mental level than those older.

4. The IQ's of the older children decrease with age to a greater extent than is found for unselected children, suggesting the retarding effect of poor homes on mental development.

5. For siblings of all ages a difference of 3 years' stay in the home corresponds to a significant difference between the IQ's of pairs separated by that difference.

6. As the length of the stay in the home increases, the mean IQ's of groups likewise decrease in a significant degree.

II. MENTAL GROWTH IN RELATION TO A SHIFT FROM AN INFERIOR HOME ENVIRONMENT TO A SUPERIOR ADOPTIVE HOME ENVIRONMENT

The study just reported raises a major question in relation to the mental development of children born to parents of low socio-economic, occupational, and educational levels: Do such children decline in rate of mental growth with increase in age irrespective of changes in the environment, or is this decline related to continued residence in an inferior home?

A study by Skodak (16) on the mental development of children from inferior homes who were placed in adoptive homes between 2 and 5½ years of age sheds further light on this question.

Sixty-five children committed to the Iowa Soldiers' Orphans' Home were included in this study. Age at time of placement ranged from 1 year, 11 months, to 5 years, 6 months, with a mean age at placement of 3 years, 7.6 months. All children had had at least one intelligence test shortly before placement in foster homes. Following a period of residence of at least one year in the foster homes, the children were reexamined. After placement, twenty-four children had two examinations at intervals of one year. Nine included in this group were children that had been in adoptive homes two or more years, with two tests available following placement. For other children only one post-placement examination was available, as their length of residence in adoptive homes was not sufficiently long to permit two tests at one-year intervals.

Status of true parents was comparable to that reported in the foregoing study by Skeels and Fillmore. In fact, many of these children were the younger siblings of the children reported in that study. Mean education (highest grade completed) of true mothers was 7.2 and of fathers, 7.5. The mean occupational classification of true fathers was

6.9, equivalent to unskilled labor. Of those known, 70.2 percent were classified as day laborers, 6.4 percent as slightly skilled, and 19.1 percent as semiskilled. One father was listed as farmer in the fourth occupational classification, and another in the third. Judging from the history records, few of the fathers held steady positions at any time, and their reputations as poor workers were well established. The records of both fathers and mothers show an unusually high incidence of mental abnormality and criminality.

Status of foster parents represents a definite selection upward over that of true parents. Mean education for foster mothers was 10.7 and for foster fathers, 9.7. The rank in occupation of the mean foster father was 3.7; the median, 4.0. The distribution covers the entire range, and differs from the distribution of the United States in having a much smaller proportion in the lower three, an unusually high proportion in the agricultural, and higher than the national proportion in the three upper classifications. Comparison of the distributions of the foster and the true fathers shows very little overlapping: 96 percent of the true fathers are from the three lowest occupational ranks; 94 percent of the foster fathers are from the four highest ranks.

The results of the intelligence tests of the entire group of children shortly before placement, at a mean age of 3 years, 4.2 months, and on reexamination following a period of residence in the foster home of at least one year are shown here in tabular form.

<i>Tests</i>	<i>Mean C. A.</i>		<i>Mean IQ</i>	<i>Percentage of Children at IQ</i>			
	<i>Yrs.</i>	<i>Mos.</i>		<i>70-80</i>	<i>80-90</i>	<i>90-110</i>	<i>110+</i>
Before Placement	3	4.2	98.5	6.2	20.	55.4	18.4
After Placement	4	4.2*	104.2	0.	17.	56.9	26.1

* Or more.

The product-moment correlation between the tests before and the tests after placement is $.61 \pm .05$, indicating that, in addition to the general shift upward, there has been considerable shifting in positions of individual cases. The critical ratio of the difference between mean IQ before placement and mean IQ after one year's residence in the foster home is 2.27, indicating that there are 99 chances in 100 that a true difference exists.

Twenty-four children had two examinations, one, one year after placement and one, two years after placement. Their mean IQ before placement was 97.9, at 3 years, 3 months. Their mean IQ after residence in the foster homes was 102.0, at a mean age of 4 years, 10 months. When reëxamined at a mean age of 6 years, 9 months, their mean IQ was 107.7. The product-moment coefficient of correlation between first and second postplacement examinations is $.76 \pm .06$. In view of the general shift upward as shown by the differences in means and the distribution for the two tests, an appreciable amount of individual shifting about had also occurred.

Relationships between mental growth of children and factors pertaining to true and foster parents have been studied in detail. Space does not permit a detailed analysis of such comparisons.

In summarizing this study the author concludes as follows:

1. There is a slight tendency for children of better educated mothers to make somewhat better improvement in foster homes than children whose mothers were less well educated.

2. Children of these ages tend to be placed selectively on the basis of the child's initial mental level and the occupation of the foster father.

3. Children of these ages and initial mental levels, when removed from their own inferior homes, gained slightly in mean IQ in the institution and continued to gain markedly in the foster homes. The gains continued over the period of study covering approximately two years of residence in the foster homes.

4. Children initially lowest in mental level gain most, while children initially highest tend to remain at their initial level. Children placed in all occupational levels gained in mean IQ, but the least gains were made by children in farming homes. Age at placement within this range was unrelated to amount of change in IQ following placement.

5. There appears to be a slight increase in stability of scores with cumulative residence after placement, in spite of the continued rise in mean IQ for the group as a whole.

6. It is seen that contrary to the evidence presented for children who remain in inferior homes, or who do not undergo marked improvements in environment, these children show an increase in gains and a reduction in losses with a corresponding increase in mean IQ with progressive changes to environments superior to those in which they were born and in which they spent their early lives.

The results thus far concur with results found by Freeman (5), Lithauer and Klineberg (9), Dawson (3), Hallowell (8), and Schott

(10), who found increases in mean IQ for various groups of children who were transferred from inferior to relatively superior home environments.

III. MENTAL DEVELOPMENT OF CHILDREN PLACED IN INFANCY IN ABOVE-AVERAGE AND SUPERIOR ADOPTIVE HOMES

A study of the mental development of Iowa children placed during early infancy in adoptive homes is being carried on coöperatively by the Iowa Child Welfare Research Station, the Iowa Board of Control of State Institutions, and the Iowa Children's Home Society. The subjects of the study are children from the lower social, economic, and educational levels who have been placed in average and superior foster homes under the age of 6 months. As planned, the study will comprise repeated mental measurements on these children over a long period of time. Results of first examinations given at the early preschool years have been presented in two articles by Skeels (11, 12). In the first, there were 73 children and in the second 74 additional ones, or 147 children in all. Skodak (16) later reported comparisons of tests and retests on 154 children, most of whom had been reported in Skeels' earlier study (12).

Since status of true and foster parents, including social, economic, occupational, and educational levels, is comparable for these different samplings, this summary will be limited to the findings reported in Skodak's study (16).

1. Status of True Mothers

a. Educational Attainment. Information was available on the education of 144 of the mothers. As nearly as can be determined, the grades represent grades completed in school; the actual achievement was probably considerably below the school grade attained. That many of the mothers were probably the more inferior members of their school classes is indicated by the large proportion of those who were over-age for their grade when leaving school. There is also the possibility that the reports of some of the mothers are unreliable; in such cases undoubtedly the reported grade is too high.

The mean grade completed was 9.9; the median, 10.0. One girl was completing her last year in college. Sixteen girls, or 11.1 percent, had had some work beyond high school. In most cases this had con-

sisted of business college or teacher-training courses. Of the girls, 53.5 percent had had some high-school work; 35.4 percent had completed Grade VIII or less.

b. Occupation. Information was available on the occupational status of 115 of the 154 mothers. Of the 115, 22, or about one-fifth, were too young to have been employed, or were students living at home, or were mentally incapable of holding positions. Thirty-eight, or about one-third, had done housework only. The remainder were distributed in such occupations as waitress, factory or packing-plant employee, telephone operator, store clerk, rural teacher, and so forth. These results agree with most studies of illegitimacy in that the majority of the mothers have been employed only in unskilled and semiskilled occupations, particularly in domestic service.

c. Mental Level. Intelligence-test results were available for 80 of the 154 mothers known by a previous study (12) to be representative of the total group. Examinations of the mothers were made by various individuals connected with the psychological staffs of the Board of Control, the University Hospital, and a municipal clinic. As far as could be determined, the scores reported here are based on the 1916 Stanford Revision of the Binet, given either in the completed or abbreviated form, with 16 years used as the maximal divisor. For the 80 mothers the mean IQ is 87.7; S. D., 15.8. The preponderance of mothers from the lower levels of intellectual attainment is shown by the small percentage of intelligence quotients classified as above average and the large percentage of those classified as below average (6.3 percent have IQ's above 110; 53.8 percent have IQ's below 90, and of these 16.3 percent are classified as borderline and 13.8 percent as feeble-minded—IQ's under 70).

d. Social Status. A large number of the families were on relief or lived in financial insecurity so marked that it was considered a major factor in making plans for the child. While the number of cases in the immediate family with records of mental defect, of dependency involving institutional care, of arrests and incarcerations was larger than would be found in a sample of the same size from the general population, and the group may be described as inferior in social status, still it is not so inferior as the social status of the mothers of children committed and placed at an older age.

2. Status of True Fathers

Cases in which identification of the father or the information concerning him was doubtful, or in which there was evidence that the information was unreliable, were considered 'unknown' and were not treated in the analysis of the data.

a. Education. Information was available on the educational attainment of 88, or 56.4 percent, of the 154 fathers. The educational mean and median were slightly over tenth grade completed, 10.2 and 10.6 respectively. Two fathers, or 2.3 percent, were college graduates; 14.8 percent had had some work beyond the high school; 48.8 percent had had some work in the high school; 36.4 percent had finished eighth grade or less. In the case of these fathers, there is again reason to believe that the actual educational attainment averaged less than the school grade reported.

b. Occupation. No information was available on the occupations of 35 of the 154 fathers. Nine were reported to be high-school or college students, with no occupational records. The remaining 110, for whom this information is available, were distributed in seven occupational categories¹ as follows: I. Professional; II. Semiprofessional; III. Skilled Trades; IV. Farmers; V. Semiskilled; VI. Slightly Skilled; and VII. Day Laborers. In comparison with the distribution of occupations of males in the entire United States a disproportionate number, or 47.3 percent, come from the lowest occupational classification of unskilled day laborer. Only two, or 1.8 percent, are in the first occupational classification; 4.6 percent are in the second; 14.6 percent, in the third; 10.9 percent, in the fourth; 10.9 percent, in the fifth; 10.0 percent, in the sixth. The mean classification of the true fathers is 5.4 (between the slightly skilled and semiskilled or about one occupational category below the average for the entire country).

In many cases although an occupation was given, the individual was actually unemployed and on relief. There appears to be sufficient evidence to conclude that, within a given occupational classification, the individuals in the group were the more inferior members of the classification. While most of this information pertained to depression years, it was more likely for the inferior carpenter to be out of work and the inferior truck driver to be on relief than for the workman who was known to be skillful and trustworthy. Comparison with the records of the foster families during these same years will illustrate this difference.

¹See Terman and Merrill (18), p. 14.

c. *Social Status.* The general social status of the true fathers was essentially the same as that of the true mothers. In addition to the evidence from the occupational classification, there was sufficient indication in the history records that the fathers, like the mothers, tended to come from families in which records of dependency and social inadequacy were not infrequent.

3. Status of Foster Parents

a. *Education.* The mean for both fathers and mothers is twelfth grade completed. Of the mothers, 13.2 percent had college degrees, and 3.3 percent had had some work beyond the B.A. degree. Of the group, 26.3 percent had had work beyond the high school, though less than a four-year course; 44.1 percent had had some work in high school or had completed it; 12.5 percent had finished eighth grade; 4.0 percent had had less than an eighth-grade education. For the foster fathers, 20.9 percent had college degrees and 12.4 percent had some work beyond the B.A. degree; 18.3 percent had gone beyond high school but not sufficiently to receive degrees; 33.9 percent had completed all or part of a high-school course, 24.8 percent had completed the eighth grade, and only 2.0 percent had had less than eight grades.

b. *Occupations.* The classification of occupations of foster fathers is subject to misleading interpretations, because in general the foster homes are selected within each occupational classification. The farmers, for example, are the more prosperous farmers; the carpenters, the more industrious and capable ones; the laborers, the best in their group; and so on. The mean occupational classification of the foster fathers is 3.1, which is approximately equivalent to that of highly skilled workman or retail-store proprietor. Of the foster fathers, 13.6 percent are in the first occupational classification; 14.3 percent, in the fifth, sixth, and seventh classifications combined. It is interesting that 25.3 percent are in the fourth, or farmer, classification, as against 15 percent for the entire country, but this is consistent with the expectation for an agricultural state.

4. Mental Development of the Foster Children

As the standard measures of intelligence, the Kuhlmann and Stanford Revisions of the Binet Scale have been used. Children under 3½ years of age at the time of examination were given the Kuhlmann

Revision; those over that age, the Stanford Revision. The mean chronological age at the time of placement was 2.8 months, with no child over 6 months of age. At the time of examination the children were from 1.5 to 6 years of age (mean C. A., 2 years). All examinations were made by trained and experienced psychologists.

Results indicate the mean IQ of the group to be 116.0 with a standard deviation of 13.6. Of the 154 children, 96 percent class as normal or above. Only 4 percent were below IQ 90 and none below IQ 80. Sixty-five percent had IQ's of 110 or above, and 41 percent 120 or above. The mean level of intelligence of these children compares favorably with that reported by Goodenough (6), Wellman (19), and Dickson (4) for 'own' children of similar age from superior occupational levels.

A second examination was available on all of these children at somewhat older ages. The mean age at the time of last examination was 4 years, 4 months. Seventy-seven percent of the children were between 2 and 5 years old. The mean IQ for the last examination was 111.5; S. D., 13.2.

Comparisons of the percentage of cases that fell at the different IQ levels at the time of first and last examination show the marked preponderance of children testing at the superior levels and the absence of children below the dull-normal level.

When the mean IQ's of the entire group on first and last tests are compared with results reported in the literature, it is seen that the means for both first and last examinations are not only above those reported by Terman for the general population, but also compare favorably with means reported by Coffey and Wellman (2), Goodenough (6), Dickson (4), and others for children selected from the higher socioeconomic levels.

Comparisons between the first and last tests of the children in foster homes show a difference of 4.6 points between the means. The ratio of this difference to the standard deviation of the difference is 2.99, indicating that a difference in the same direction can be expected in 99 of 100 similar samples. However, in spite of a decline in mean IQ of the group, no foster child on last examination had an IQ less than 80, and the entire group remained well above the mean of the population as a whole.

Various additional analyses have been made relating the mental growth of the children to such factors as age at time of examination,

intelligence of true mothers, and status of true and foster parents, including education, occupation, and social and economic levels. From these various comparisons and analyses of results the following summary is given:

1. The mental level of the foster children on first examination was above the average of the general population and above the level of expectation, judging from the data available for the true parents. On reëxamination, in spite of a decrease in mean IQ, the mental level of the foster children still remained well above the mean for the population as a whole, and higher than would be expected from the level of the true parents.

2. With increase in age there appeared a decrease in mean IQ, the most noticeable decrease occurring between the ages of one and two years.

3. When divided on the basis of foster-father occupation, the children in the three upper occupational categories are consistently above the mean of the total group, while children in the four lower categories are consistently below the mean of the total group.

4. At one year of age the differences in mental levels of the children on the basis of occupational classification of foster parents are negligible, but at older ages they are marked, and when grouped by intervals of over one year, are statistically significant.

5. The mental growth curve of the children in homes of the three upper occupational levels is characterized by a slight drop from the level of the first year and a fluctuation about this point. This curve does not show the marked and consistent decline in mean IQ characteristic of children placed in less superior homes.

6. The mental growth curve of the children in homes of the lower occupational classifications is characterized by a marked drop after the first year to a level slightly above the mean of the general population by the age of four, and then a maintenance of that level to the end of the period covered in this study.

7. The relation between child's IQ on first examination and the education of the foster parents, although positive, is practically of zero order. On re-examination, the coefficients of correlation between child's IQ and foster-parent education rise to the order of .16 to .19, but remain smaller than values frequently reported for children and true parents in their own homes.

8. The results of a measure of the home environment show a coefficient of correlation of .49 with child's last IQ. A marked difference was found between environmental scores for children of high and low IQ's but no difference was found for children who had gained or lost varying amounts between examinations.

9. Selective placement had occurred to some extent in that a slight positive correlation was found for true-parent and foster-parent education. The mean occupational classification of true fathers was somewhat higher for the higher type of foster homes and the mean IQ of the true mothers was slightly higher in some of the upper groups of foster homes. Selection was more evident in comparisons of certain subgroups than it was for the total group. In certain other subgroups selective placement appeared to be negligible.

10. The coefficients of correlation between the child's first IQ and true-parent education ranged from .04 to .11, and on second examination from .28 to .33. While the coefficients are less than those often reported for parents and children in their own homes, they are slightly higher than similar correlations for the foster parents.

11. The coefficients of correlation between true-mother's IQ and child's IQ increase from .06 to .24 from first to second examination.

12. The mental level of the true mothers showed less relationship to the mental level of the children than did the occupational classification of the foster homes in which the children were placed.

13. The mental development of children of feeble-minded mothers and the most inferior true-family backgrounds is indistinguishable from that of children whose mothers are not feeble-minded. Children placed in superior or in inferior foster homes follow the same pattern of development shown by the entire group of children placed in similar homes.

14. The mental development of children whose fathers came from the lowest occupational classification, that of unskilled laborers, was indistinguishable from the developmental pattern of the entire group of children. Those children placed in superior or in inferior foster homes have the same mean mental levels as all children placed in similar homes and examined at the same mean ages.

15. Children who were the most extreme on initial IQ made the greatest changes. Those initially lowest made the largest gains and those initially highest suffered the largest losses. Change from losses to gains occurred at about 110 IQ.

16. Children who show marked gains or losses between the first and the last examinations cannot be reliably differentiated on the basis of true-parent and foster-parent education or occupation.

17. Children whose final IQ is above 115 have an initial IQ above the average of the total group. Their foster parents are markedly superior to the foster parents of children whose final IQ is under 104 and superior to the foster parents of the group as a whole. The true parents of the superior children are somewhat higher on the available measures than the true parents of children under 104 IQ.

5. Summary on All Children Placed under Six Months

Since the foregoing studies of children placed in infancy in adoptive homes have been completed and reported, many additional cases have been added. Therefore, it seems advisable to summarize briefly all the cases now available.

Data are now available on 306 children, all under 6 months of age when placed in adoptive homes. Of this number, 212 had been wards of the Iowa Soldiers' Orphans' Home, 87 had been wards of the Iowa Children's Home Society, and 7 had been placed through private sources. Mean age at time of placement was 2.8 months (S.D., 1.5). The range extended from 2 days to 6 months.

Psychological examinations were made at the time the foster parents requested permission to complete the adoption, which was one year or longer after placement. Children under 3½ years at examination were given the 1922 Kuhlmann-Binet; the others, the 1916 Stanford-Binet. The mean age at time of examination was 22.7 months (S.D., 13.4).

Results indicate the mean IQ of the group to be 117.2 (S.D., 14.5). The lowest IQ was 80; the highest, 181. Of the 306 children, IQ's of 120 and better were obtained by 45 percent; 110 and better ('superior') by 72 percent; 90 and better ('normal' or better) by 97 percent; 80-90, by only 3 percent. These figures are comparable to the results reported earlier by Skeels (11, 12) and Skodak (16) on smaller numbers of cases. Since the true parents and the foster parents of these additional children are comparable to those reported in the more detailed studies (12, 16), the analyses there set forth are applicable to the total group of 306 children.

IV. MENTAL GROWTH IN RELATION TO A SHIFT FROM A RELATIVELY NON-STIMULATING INSTITUTIONAL ENVIRONMENT TO ONE OF MORE MARKED STIMULATION VALUE

As a further approach to this question of modifiability of intelligence, a study was made by Skeels and Dye (13) to determine the effects on mental growth of a radical shift in institutional environment to one providing superior stimulation, introduced into the lives of mentally retarded children of early preschool ages.

Thirteen children, mentally retarded, under three years of age, and residing in the Iowa Soldiers' Orphans' Home, were transferred to the Iowa Institution for Feeble-minded Children as guests in resi-

dence for a period of time. The mean chronological age at time of transfer was 19.4 months. The range of IQ's was from 35 to 89, with a mean of 64.3 and a median of 65.0. That such retardation was real and observable was substantiated by the reports of the pediatrician, the nurse in charge, and observations of the children in the nursery group. All children were considered unsuitable for placement in adoptive homes because of low mentality.

Following transfer, these children were placed as singletons and in some cases by two's, in wards with the brighter older girls. Preliminary observation had shown that such an environment was stimulating to the mental growth of retarded children of these ages. The older inmates, 30 to a ward, ranged in age from 18 to 50 years, with mental ages from 6 to 12 years. The girls took great interest in these 'babies,' spending much time with them, teaching them to walk, talk, and play with toys and play materials, and in the training of habits. In addition, these children attended the school kindergarten, which was in the nature of a preschool. They also attended the institutional chapel exercises, games, and entertainments. The attendants on the wards were also very much interested in the children and gave generously of their time and affection. For children of these ages this environment was more enriched than could have been provided through boarding-home care.

As a contrast group, 12 children of similar ages, but of a higher initial mental level and residing in the orphanage until approximately 4 years, were studied. The mean IQ at the beginning of the study period was 86.7. The environment of the children in the contrast group was considered to be representative of the average orphanage. The outstanding feature was the profound lack of mental stimulation or experiences usually associated with the life of a young child in the ordinary home. Few contacts with adults were possible other than those involving physical care, because of the large numbers of children and the limited staff.

Both groups were comparable as to physical and medical status, birth history, and family history. Children of both groups were considered as being free from gross organic and physiological defects. They were from the lower socio-economic, occupational, and educational levels of society. The family background was comparable to that reported by Skeels and Fillmore (14) in their study of the mental development of children from 'under-privileged' homes.

TABLE I.—CENTRAL TENDENCIES (MEAN, MEDIAN, AND STANDARD DEVIATION) FOUND IN COMPARING MENTAL GROWTH FROM FIRST TO LAST TEST ON THE PART OF EXPERIMENTAL AND OF CONTRAST GROUPS

<i>Measure</i>	<i>C. A., in Months</i>	<i>M. A., in Months</i>	<i>IQ</i>	<i>C. A., in Months</i>	<i>C. A., in Months</i>	<i>M. A., in Months</i>	<i>IQ</i>	<i>Length Expt'l Period, in Months</i>	<i>Change in IQ, First to Last Test*</i>
Experimental Group (13 Children)									
	<i>Before Transfer</i>			<i>Transfer</i>			<i>After Transfer</i>		
Mean.	18.3	11.4	64.3	19.4	38.4	33.9	91.8	18.9	+27.5
S. D.	6.6	4.2	16.4	7.4	17.6	13.0	11.5	11.6	15
Median.	16.6	10.8	65.0	17.1	36.8	30.0	93.0	14.5	+23
Contrast Group (12 Children)									
	<i>First Test</i>			<i>Last Test</i>					
Mean.	16.6	14.2	86.7	47.2	28.7	60.5	30.7		-26.2
S. D.	2.9	2.9	14.3	5.9	6.4	9.7	5.8		14.1
Median.	16.3	13.6	90.0	49.3	29.3	60.0	28.8		-32.5

* Medians based on individual changes.

Intelligence tests were given to members of both groups at the beginning of the project and at intervals during the course of the study by experienced and trained psychologists.

The results in terms of central tendencies are presented in Table I.

The average gain in intelligence quotient for the experimental group during the course of the experiment was 27.5 points, with a median of 23. The differences between first and last tests yielded a critical ratio of 6.3, or a practical certainty of a true difference. Every child showed a gain; the range was from 7 points to 58 points.

The mental growth pattern for children of the contrast group was quite the opposite from that of the experimental group. The mean IQ on first examination was 86.7; on the last test, 60.5, showing an average loss of 26.2 points. The critical ratio of the differences was 6. With the exception of one child who gained 2 points in IQ from first to last test, all children showed losses; the range was from -8 points to -45 points. Ten of the 12 children lost 15 or more points in IQ.

These results, although more marked, are comparable to the findings reported in the orphanage preschool study by Skeels, Updegraff, Wellman, and Williams (15).

That the gains in intelligence evidenced by the children of the experimental group were true gains and not due to artificial results in testing seems validated. Improvement was noted independently by members of the medical staff, attendants and matrons, and school teachers.

As has been indicated, all 13 children of the experimental group were considered unsuitable for adoption because of mental deficiency. Following the experimental period, 7 of these children have been placed in adoptive homes. Of the remaining 6, 5 are considered to be well within the range of normality and have been returned to the orphanage. Only one child (IQ 77) is continuing in residence at the school for feeble-minded for further observation as to subsequent mental development.

A summary of results and conclusions follows:

1. Over a period of 2 years the mean level of intelligence of the experimental group increased markedly, while that of the contrast group showed an equivalent decrease. The experimental group made an average gain of 27.5 points of IQ, while the contrast group showed a mean loss of 26.2 points.

2. Critical ratios based on differences between first and last tests for experimental and contrast groups were 6.3 and 6.1, respectively.

3. A change from mental retardation to normal intelligence in children of preschool age is possible in the absence of organic disease or physiological deficiency by providing a more adequate psychological prescription.

4. Conversely, children of dull-normal intelligence may become mentally retarded to such a degree as to be classifiable as feeble-minded under the continued adverse influence of a relatively non-stimulating environment.

5. An intimate relationship between the child and an interested adult seems to be a factor of importance in the mental development of young children.

6. In a child-placing program, if children are to be withheld from placement in adoptive homes pending further observation of mental development, it is imperative that careful consideration be given to the type of environment in which they are to be held.

7. The possibility of increasing the mental capacity of 'functionally' feeble-minded children should be considered as an essential objective in setting up an individualized treatment and educational program in a school for feeble-minded.

V. DISCUSSION OF CRITICISMS

Two questions raised by other investigators relative to the sampling of children included in the Iowa studies of foster children deserve further consideration at this time:

First: What percentage of all children placed under 6 months of age by these two agencies (Iowa Soldiers' Orphans' Home and Iowa Children's Home Society) have been examined? The earlier studies of Skeels (11, 12) and Skodak (16) include only children for whom completion of adoption was requested. The suggestion is therefore made that perhaps the persons who wished to complete adoption were those having prospective foster children showing promising mental development, whereas those having children of a lower level of mental development failed to complete adoption.

Second: What is the relation of the percentage of children placed in adoptive homes to the total number of children committed to these two agencies under 6 months of age during a given period? Since it has been indicated that only physiologically and medically sound babies were placed, what percentage of committed babies was not considered suitable for placement and on what grounds? If this percentage was high, might this not account for the superior mental development of the 'selected' placement group?

Concerning the first question, the number of children examined in relation to the total number of children placed under 6 months,

data were available on children placed from the Iowa Soldiers' Orphans' Home during a five-year period (1933 to 1937, inclusive) and from the Iowa Children's Home Society during a three-year period (1934 to 1936, inclusive). During these years, 171 children from the Iowa Soldiers' Orphans' Home, and fifty-three from the Iowa Children's Home Society, a total of 224, were placed in adoptive homes under 6 months of age. Of this number, 204 children, or 91.1 percent, have been given intelligence tests. The mean IQ on this group, 118.7 (S. D. 14), is comparable to the figures for the sampling reported in the Skodak (16) and Skeels (12) studies. There is every reason to assume that the level of intelligence of the 20 children, or 8.9 percent, who were not examined is not far different from the group examined. Of the 20 children not examined, 10 have been adopted, but for one reason or another the psychological examination was not made prior to the adoption. Four families had moved out of the state.

Adoption has not been completed on the other 10 children, but in one case application has been made, and reports of the home visitors available on all these children indicate normal mental development.

The second question relates to the percentage of babies placed, out of the total number committed, under 6 months of age during a given period of time. All babies committed under 6 months of age to the Iowa Soldiers' Orphans' Home during a 5-year period (1933 to 1937, inclusive) and also all babies committed under that age to the Iowa Children's Home Society during a 3-year period (1934 to 1936, inclusive) have been accounted for. During this period, 302 babies were committed to the Iowa Soldiers' Orphans' Home and 88 to the Iowa Children's Home Society, 390 in all.

From this number several deductions are necessary. Nine babies were colored children and for the purpose of this study have been excluded. Thirty-five children were not subject to adoption because commitment prohibited placement in foster homes. Of this number, 31 were returned to the homes of relatives and 4 were transferred to other agencies. Since this study is not concerned with the mental development of children in their own homes, these have been excluded. Twenty-one babies died in early infancy. Six additional children were unplaceable because of physical or physiological defects (one born blind, one a mongol, one with birth injury, one with congenital heart defect, one without hands, and one with general physiological defect).

After these eliminations there remained 319 babies, of which 308, or 96.6 percent, have been placed in adoptive homes. Consequently, only eleven children, or 3.4 percent of the 319 children available for adoption, have not

been placed. Unplaced children include 4 withheld from placement because of unusually poor family histories, 2 luetic children, 2 with chronic ear difficulty, 1 with chronic upper respiratory infection, and 2 for reasons not classified.

Of the 308 babies committed under six months and placed, 224 were placed before, and 84 after, the age of six months. A number of children were near 6 months of age at the time of commitment and of necessity could not be placed until after reaching 6 months of age because of the time required for medical examinations, observation, and assignment to the adoptive homes. Still others required temporary medical care and more prolonged observation before placement could be consummated.

Concerning the studies relating to the mental development of children placed in adoptive homes in infancy, some of the critics have postulated that the true parents of these children were an average or even superior group. A careful evaluation of case histories makes it difficult to arrive at such a conclusion. Qualitative aspects of these case histories are referred to earlier in this presentation. Moreover, it is suggested that the reader consider the more detailed presentation of the complete studies by Skeels (12) and Skodak (16). On occupational classification of true fathers a direct comparison is given with the distribution of occupations of males in the United States. It is seen that a disproportionate number of true fathers (47.3 percent) come from the lowest occupational classification of unskilled day laborer. This is in contrast to only 19.5 percent of the population as a whole falling in that class. Only two true fathers, or 1.8 percent, are in the first occupational classification as against 3.1 percent for the general population. The mean occupational classification of the true fathers is 5.4, which would fall between the slightly skilled and semiskilled and is about one occupational category below the average for the entire country.

Education of true parents as measured by grade 'reported' completed presents a somewhat more controversial issue. In Skodak's study (16) the mean grade completed for mothers was 9.9 and for fathers 10.2. A direct comparison for similar age groups for the country as a whole is not available. The Office of Education of the United States Department of the Interior gives as a rough estimate for the population 21 years of age and older, elementary-school graduation as the median of 1934. This estimate is further qualified by the statement that, with about 38 percent of those entering school

graduating from the high school and about 5 percent from the college today, and with the aged who are dying in the relatively uneducated groups, the median education will continue to rise.

It is to be noted that the Iowa studies of foster children are recent and that the true mothers and fathers are young. A comparison with the country as a whole that includes all ages is therefore not adequate, as such a group would include many persons over 50 or 60 years of age and a period when educational opportunities were relatively more limited.

In Iowa compulsory schooling through age 16 is the rule, and a substantial part of this schooling is still done through one-room rural and small-town schools without benefit of testing programs, psychologists, or clinics. Even the dull tend to get pushed up, grade after grade. As already said, we have some evidence that these mothers gave the highest grade entered as the grade completed, and also that their school records were inferior. In Skeels' study (12), it was pointed out (p. 35) that a qualitative analysis of social histories seems to indicate that, within these educational and occupational classifications of true parents, the individuals represent the lower levels in such groups. Further data relating to these considerations are being secured at the present time.

Skodak (16), in her study on retests of the children in foster homes, found a positive relation between IQ's of children and extremes in education of true parents (pp. 77 and 78). The mean IQ for children whose true-parents' education was eighth grade or less was 104 for 21 cases. For children with both parents having gone beyond high school, the mean IQ based on 10 cases was 122. The critical ratio was 3.23. Some investigators feel that the study has failed to give due emphasis to this relation. Here, again, there are reservations to be made before such a conclusion can be drawn. Selective placement, as operating in general in the study, is shown by a correlation of .30 between true-midparent and foster-midparent educations. However, for children from parents having a midparent education beyond the high school, selective placement was felt to operate to an even greater degree. It was only natural placement procedure to make a special effort to secure superior foster homes for such children. The mean foster-parent occupational classification for children from true parents with education of eighth grade or less was 3.29, and for children from parents who had gone beyond the high school, 2.50. This shows a

distinct advantage in terms of foster fathers' occupational status for the children whose true parents had gone beyond the high school. Furthermore, it so happened that the children from the true parents of higher educational attainment were younger when examined, than those from parents at a lower educational level. Since for the entire group of children the tests at the younger ages were slightly higher, this circumstance may have accounted for a part of the difference.

In this connection attention should be called to the subsection of the Skodak (16) study relating to the mental development of children from feebleminded mothers. In this group, 16 children were studied whose true mothers were feebleminded and whose fathers were of low educational status. It was found that the mental development of these children was indistinguishable from that of children whose mothers were not feebleminded. Children placed in superior or inferior foster homes followed the pattern of development shown by the entire group of children placed in similar homes.

A word should be said with reference to the statistical concept of 'regression' as it applies to studies involving repeated tests. The Skeels and Dye study (13) is cited as an example. Because tests in general are not completely reliable, if a group is selected on a basis of low initial test score, it is logical to assume that on retest such a group would score somewhat nearer the mean. The experimental group of 13 children on first test had a mean IQ of 64.3 and on last test a mean IQ of 91.8, a gain of 27.5 IQ points. Some of this change might be credited to regression, but it would seem unjustifiable to account for such a marked change entirely in terms of regression. When we turn to the contrast group we are forced to account for change in terms of factors other than regression. The 12 children in this group had an initial mean IQ of 86.7 and a final IQ of 60.5, or a mean loss of 26.2 points. On initial IQ the mean for this selected group was below that for an unselected population and equivalent to the mean of all of the orphanage children. In terms of regression, the mean IQ of these children on subsequent tests should be equivalent to, or slightly higher than, that obtained on the first test. Instead, we find a drop as great as the gain made by the experimental children. How, then, can regression account for the opposite trends in mental growth evidenced by the two groups?

VI. SOCIAL IMPLICATIONS

In summary the implications set forth in the Skodak study (16) are applicable to the several studies that we have reviewed here.

Certain broad generalizations emerge from the results of this study.

1. The first is that intelligence as commonly defined is much more responsive to environmental changes than had previously been conceived.

While marked changes had been found under certain especially stimulating conditions of education, similar changes can be brought about by changes in home conditions. The changes found in this study by no means exhaust the possibilities, since the homes would be described as good middle-class homes, above the average in education and socio-economic status, and superior in interest in children, but by no means selected on the basis of extraordinary opportunities for a child's mental development. No attempt was made to give the foster parents systematic training or instruction in techniques of child care that appear to be stimulating to mental development. Furthermore, during the time the placement of these children occurred, placements were made with caution and homes that appeared to have very high standards were occasionally passed over in favor of an average home that, it was felt, would not make excessive demands on a child who might be of mediocre ability.

Evidence from this study indicates that, within a wide range, it is the home rather than the child's true-family background that for practical purposes sets the limits of his mental development.

2. A generalization that springs as a corollary is that the rather close relation reported between the intelligence of own parents and older own children is in part the result of environmental impacts on the child—the environment being largely determined and governed by the parents.

That these influences are cumulative is shown by the studies that find little relation between the intelligence of very young children and various measures of parental ability, while the differences between groups of older children divided on the basis of parental occupation, for instance, have been repeatedly demonstrated.

3. Indications from studies of the changes in mental development with changes in environment are that any hereditary constitutional factor that sets the limits of mental development operates within broad limits. Within these, environmental factors can operate to produce changes that occasionally may represent a shift from one extreme to another of the present distribution of intelligence among children.

4. The results of this study have certain practical social implications.

For children who remain in their own homes the evidence presented here is primarily of theoretical rather than of practical interest, but it does place the responsibility for the mental development of the young child on the parents to an extent rarely appreciated.

For those children who do not remain in their own homes, there are certain immediate, practical implications. The evidence from this and other studies, indicates that the mental level of the child is significantly related to the type of home in which he grows up. Continued residence in an inadequate home results in a decline in mental level with increase in age, whereas placement in a superior home, even during the later preschool years, results in an increase in mental level compared to expectation from the information about the true parents. It becomes necessary to reevaluate the types of homes that are to be considered adequate for the care and best development of the child. Financial support of a family does not necessarily guarantee that the best interests of the child will be protected in a home that is unable to meet his developmental needs.

Those children placed in early infancy show mental development considerably higher than that of children placed during the preschool ages. It is the common observation of placement workers that it is not possible to place older children, even of preschool ages, in homes of as high a type as it is young infants. Therefore, if there is any question of removing some, but not all, of the children from a home it would appear that the youngest child, having been exposed to an inferior environment for the shortest time, is the one who, from the standpoint of his opportunities for placement and his possible future mental development, should be considered for removal first. In the case of illegitimate children the same conditions exist. Very rarely is the unmarried mother able to give her child an opportunity for even relatively adequate development. Placing the child in a good foster home at the youngest possible age makes for development equal to that of own children in similar homes.

5. Since the relationship between true-family background and the child's mental development is very low, and since knowledge of the child's true-family history has little or no predictive value, the use of true-family histories as a basis for the placement of the child is doubtful.

6. The practice of withholding a child from placement because of inferior true-family background jeopardizes his opportunities for placement in an above-average home as he grows older and subjects him to the less stimulating environment of an institution. Evidence

on the development of children in professional boarding homes is not available at this time.

7. In the placement of children of preschool age, the caution exercised in order to secure selective placement appears to be rather unwarranted.

Children above the feeble-minded level, but below average in intelligence, made marked gains even in relatively inferior homes. What they might have achieved in superior homes can only be conjectured. The practice of systematically selecting mediocre homes for below-average children is probably penalizing these children in terms of their future mental development. The objective with the older children of preschool age should, therefore, be the same as that with infants; that is, the selection of the best possible home for the child, rather than systematic selective placement. The most important problem in child-placing, therefore, is the selection of the home and family of which the child is to become a member.

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CHAPTER XXI

THE MENTAL DEVELOPMENT OF CHILDREN OF FEEBLE-MINDED AND NORMAL MOTHERS

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Social agencies are unwilling to place for adoption, and prospective adoptive parents are unwilling to accept, children whose true mothers are mentally defective, both fearing that the child will likewise be mentally deficient.

There is very little experimental information upon which to base the attitude of the agency. As most agencies are unwilling to experiment with the lives of their clients, it is not probable that an investigation of this problem could be set up. The prevalent practice of placement in boarding homes, however, does make it possible to investigate in homes similar to adoptive homes the mental development of children whose mothers are feeble-minded.

Skeels¹ and Skodak² have published studies indicating that children of feeble-minded mothers, placed in foster homes at or before 6 months of age, develop normally. Freeman³ found a mean IQ of 95.1 for children of one defective parent, when the children were placed in foster homes before the age of 5.

These data, in the face of the attitude of the agency, are truly surprising. Is the attitude based on feeling rather than fact, or are these studies exceptions? Frankly feeling that these studies would prove to be exceptions, or that the mothers in these investigations were not truly defective, we decided to study a group of children of

¹ H. M. Skeels. "Mental development of children in foster homes." *Jour. Consulting Psychol.*, 2, No. 2: 1938, 33-43.

² M. Skodak. "The mental development of adopted children whose true mothers are feeble-minded." *Child Develop.*, 9: 1938, 303-308.

³ F. N. Freeman, K. J. Holzinger, B. C. Mitchell, and others. "The Influence of Environment on the Intelligence, School Achievement, and Conduct of Foster Children." [In] *The Twenty-Seventh Yearbook of this Society, Part I*, 1928, pp. 103-217.

feeble-minded mothers, regardless of the age at which they had been removed from their own homes and placed in foster homes.

With the coöperation of the Children's Service League, the child-caring agency responsible for all dependent children in Sangamon County, we have been able to make a study of all dependent children in any type of foster home. The investigation of the mental development in their own homes of children whose true mothers are feeble-minded is a part of this larger study, which is still incomplete.

I. SUBJECTS

Sixty-eight physically normal children, whose mothers are definitely feeble-minded by test results and social criteria, are at present under care of the Children's Service League. All but one of the mothers were committed to state institutions for the mentally defective. The mean IQ of the mothers is 49.0, with a range from 38 to 64. The children have been declared dependent by the Juvenile Court, and have been placed in boarding homes selected and supervised by the Children's Service League. These children will be referred to as 'Group A.'

We have been able to trace with some detail the family histories of 5 of these mothers. In all 5 the mother, one or both of the grandparents, and one or more of the great grandparents, have been mentally deficient. There are in addition numerous instances of epilepsy, psychopathy, illiteracy, and moral degeneracy in these and collateral relatives. We have not been able to obtain equally detailed information about the other mothers of this group, but such information as we have obtained leads us to believe that they come from similarly deficient and inadequate family groups.

In order to obtain a control group, a number of cases were selected at random from the files of the Children's Service League. From this group we excluded all cases where the mentality of the mother had been questioned, even though no psychometric or other data were given to support the suspicion of mental deficiency. This left 57 dependent children, whose mothers, apparently normal by social criteria, had died or deserted. These children, who have also been placed in foster homes selected and supervised by the Children's Service League, will be referred to as 'Group B.'

The fathers of the children of both groups are, as a class, inadequate. They were largely employed, if employed at all, in un-

skilled labor, although a few of the fathers of Group B children were engaged in semiskilled and skilled trades. The histories reveal very little differences between the fathers of the two groups. In both groups, the fathers are described as irresponsible, alcoholic, epileptic, mentally ill, or venereally diseased.

There was no difference in policy governing admission or method of placement for these two groups, except that children in Group A were not placed in adoptive homes. None of the children in Group B is in an adoptive home, but many of them are in free homes or homes that may become adoptive. With the exception of a few children who were given temporary care for less than 6 months in the Children's Home, all the children of both groups were placed in boarding homes directly from their own homes.

<i>Age at Testing, in Years</i>	<i>Group A (68)</i>			<i>Group B (57)</i>		
	<i>Num- ber</i>	<i>Mdn IQ</i>	<i>σ</i>	<i>Num- ber</i>	<i>Mdn IQ</i>	<i>σ</i>
0 to 2	1	100.				
3 to 5	10	92.5	12.7	8	94.0	19.0
6 to 8	19	71.2	17.0	13	95.0	11.0
9 to 11	15	81.0	16.7	14	94.0	12.5
12 to 15	23	54.1	14.1	22	90.0	17.8

The age at which these children have been placed has not been influenced by any factor other than the need for care. When the mother died, deserted, or was declared incompetent, *all* children in the family under sixteen years of age were declared dependent and placed in boarding homes.

Children 12 years old or older were generally given intelligence tests¹ before placement in boarding homes. Children under three or four were generally not examined for two or three years. Almost all the other children were examined within three months after placement. It is felt that the disruption of the home is an episode so disturbing that psychometric examination is seldom justified at that time.

II. RESULTS

The distribution of the IQ's for the two groups, in relation to the age at testing, is shown above.

¹ The 1916 Stanford-Binet test was used in all cases but one, in which the Kuhlmann-Binet was used.

The next tabulation presents the distribution of IQ's for the two groups in relation to the age at which the child was removed from his own home. It will be seen that the children of Group B, at all ages, tend to be classed as average. The children of Group A show a strikingly different trend. There is a sharp and consistent drop in IQ the longer the child has been in his own home.

Age at Placement, in Years	Group A (68)			Group B (57)		
	Num- ber	Mdn IQ	σ	Num- ber	Mdn IQ	σ
0 to 2	12	100.5	8.0	9	97.3	8.4
3 to 5	19	83.7	11.9	9	96.7	12.7
6 to 8	12	74.6	13.6	18	91.7	11.8
9 to 11	9	71.5	10.5	14	95.0	12.6
12 to 15	16	53.1	7.0	7	82.3	10.3

It should also be noted that not one of the children of Group A, placed before the third birthday, has an IQ below 90; and that no child in Group A, placed after the twelfth birthday, has an IQ above 70.

Skeels and Fillmore¹ found that the IQ's of their economically underprivileged children were directly related to the length of stay in their own homes. The data for Group B are somewhat similar to their results. However, the children of both our groups come from homes that are definitely of low economic status. The only measurable difference in the homes of the two groups is the mental status of the mothers. If, then, the slight decrease in median IQ of Group B children can be accepted as the measure of the effect of economic deprivation, the differences between the median IQ's of the two groups might be taken as a measure of the effect of the presence of the mentally deficient mother. It will be noticed that the difference becomes greater, the longer the children have been in their own homes.

The two previous tabulations present data for all the children, regardless of family grouping. We felt that it would be of interest to compare the development of siblings, placed at the same time, but

¹H. M. Skeels, and E. A. Fillmore. "Mental development of children from underprivileged homes." *Ped. Sem. and Jour. Genet. Psychol.*, 50: 1937, 427-439.

obviously at different ages. We included all siblings where the age difference was at least 2 years, and where the siblings would be in different age groups in the tabulation. That is, there are no two children of the same family in any age group. The results next to be tabulated are almost identical with those found for the entire group:

<i>Age at Placement, in Years</i>	<i>Group A (36)</i>		<i>Group B (12)</i>	
	<i>Num- ber</i>	<i>Mdn IQ</i>	<i>Num- ber</i>	<i>Mdn IQ</i>
0 to 2	7	102.1	2	94.5
3 to 5	8	81.2	1	95.0
6 to 8	9	66.7	4	94.0
9 to 11	5	69.0	3	82.0
12 to 15	7	55.8	2	82.5

The following tabulation presents a summary of the results found in three previous studies, compared with the present data. A negative relation between the length of time in his own home and the IQ of the child is apparent. There also appears to be a positive relation

<i>Author</i>	<i>Mothers' Mean IQ</i>	<i>Age Placed</i>	<i>No. of Child- dren</i>	<i>Child's Mean IQ</i>
Freeman, et al	Defective	Before 5 years	86	95.1
Speer	49.0	Before 3 years	12	100.0
Skeels	61.6	At 6 months	9	112.0
Skodak	66.4	At 3 months	16	116.4

between the mean IQ of the mother and the mean IQ of the children. The data, however, refer only to a part of the total number of children of these mothers. There is no evidence in these studies that the IQ's of the mothers are significantly related to the IQ's of the total group of their children. Snygg¹ has indicated that the relation, if any, is not statistically significant.

¹ D. Snygg. "The relation between the intelligence of mothers and of their children living in foster homes." *Ped. Sem. and Jour. Genet. Psychol.*, 52: 1938, 401-406.

III. SUMMARY AND CONCLUSIONS

The present chapter has dealt with the mental development in their own homes of children whose mothers are mentally deficient, compared with the development of a group of children whose mothers are normal.

The data indicate that the Binet IQ of children whose mothers are feeble-minded is directly related to the length of time the children have spent in their own homes—a relation that does not appear in children whose mothers are mentally normal. This result is contrary to our expectations.

The data presented here do not support the position of agencies in refusing to place for adoption children of mentally deficient mothers. In so far as the data of the present study are concerned, there is no reason why physically normal children of feeble-minded mothers may not be placed for adoption, from their own homes, provided this is done before the third birthday.

■

CHAPTER XXII

IQ CHANGES OCCURRING DURING NURSERY-SCHOOL ATTENDANCE AT THE MERRILL-PALMER SCHOOL¹

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I. INTRODUCTION

Recent research has shown that the IQ can be changed. There is still a question as to the nature of the circumstances bringing about such a change.

Wellman² has shown gains in IQ to be associated with attendance in the University of Iowa schools—preschools and elementary and high schools. Matched preschool and non-preschool groups showed gains for the preschool group and slight losses for the non-preschool group. A comparison of a continuous group of University Elementary School children with a transfer group showed that children remaining in the University School continued to gain in IQ, while those transferred to other schools maintained the gains acquired in the University School, but did not add to them over a period of 4 to 8 years.

Goodenough,³ however, compared nursery-school children with non-nursery-school children and found that both groups gained in IQ.

¹ The writers wish to express their appreciation to Miss Dorothy Tyler, who edited the manuscript; to the various Merrill-Palmer staff members who made valuable criticisms; and to the several NYA students who gave competent assistance in tabulating.

² B. L. Wellman. "The effect of preschool attendance upon the IQ." *Jour. Exper. Educ.*, 1: 1932-1933, 48-69.

B. L. Wellman. "Growth of intelligence under differing school environments." *Jour. Exper. Educ.*, 3: 1934-1935, 59-83.

³ F. L. Goodenough. "A preliminary report on the effect of nursery-school training upon the intelligence-test scores of young children." [In] *The Twenty-Seventh Yearbook of this Society*, Part I, 1928, 361-369.

She attributed these changes to irregular standardization of the scale at the early age levels.

In any study of the IQ, the results obtained depend to a certain extent upon the method of analysis employed. Only when the methods for two studies are identical can the results be satisfactorily compared. The data in the present study are analyzed according to the methods employed by Wellman in order to permit a direct comparison of the results of the two studies.

II. PURPOSE

The purpose of this study was, by examining the Merrill-Palmer and Stanford-Binet test records of children who have attended the Merrill-Palmer Nursery School, to find out what happened to the IQ during nursery-school attendance; and if changes were found, to determine whether they were spurious or real.

III. SUBJECTS

The children whose tests are used in this study attended the Merrill-Palmer Nursery School sometime between 1922 and 1937.

The Nursery School, which opened in January, 1922, is primarily a training and observation center for undergraduate and graduate students. From 1924 to 1933 there were two nursery schools housed separately, the age range of the younger group being from 18 months to 3 years, 8 months, and of the older group from 3 years, 5 months, to 5 years. Children leave the nursery school at the end of the term following their fifth birthday. Before 1924 there was only one group, the ages ranging approximately from 2 to 5 years. Since 1933, again, there has been only the one group. The enrollment of the younger group was 25, of the older group 30, and of the single group about 35. During the morning this latter group is divided into a younger and an older group for all but routine activities. The children arrive in the morning between 8:30 and 9:15 o'clock and leave in the afternoon between 3:00 and 4:00 o'clock.

The staff consists of a supervisor, a head teacher, an assistant teacher, various part-time assistants and specialists, such as a dietitian and a music teacher, and a changing group of four student workers. Other Merrill-Palmer staff members are in the nursery school for brief periods and on special occasions. There are always student observers and frequently there are visitors, who observe in the room rather than behind a screen, as in some observation schools.

The nursery-school children come from families of the middle class, with all the variations of socio-economic status implied by this term in America. Some of the parents are of the professional class; others hold important or humble positions in the business world. Rarely is the laboring class represented. Both in educational background and in occupation, the group is in general a superior one.

After leaving nursery school most of the children attended public schools in Detroit, but a few were enrolled in small private schools. Of the 72 children tested after leaving nursery school, 57 attended the Merrill-Palmer Recreational Clubs at some time.

The children are considered in three groups: (1) those given Merrill-Palmer tests while attending the Nursery School; (2) those given Stanford-Binet¹ tests while attending Nursery School; and (3) those given Stanford-Binet tests while attending the Nursery School and also after withdrawal from it. Any one child may be considered in all three groups.

IV. PROCEDURE

All mental tests were given by trained examiners on the staff of the Merrill-Palmer School.

Children were given initial Merrill-Palmer tests within 2 weeks before and 1 month after entering our Nursery School, and were retested after an interval of not less than 6 months and not more than 3 years, 4 months. The age range was from 1 year, 7 months, to 4 years, 2 months, with a mean of 31.1 months, at the time of the initial test; and 2 years, 4 months, to 5 years, 1 month, at the time of retest. All children attended the school continuously during the interval between tests.

Children were given initial Stanford-Binet tests within 1 month before and 6 weeks after entering the Nursery School, and were retested after an interval of not less than 6 months and not more than 3 years, 4 months. The age range was from 2 years, 7 months, to 4 years, 6 months, with a mean of 41.2 months at the time of the initial test; and 3 years, 6 months, to 5 years, 3 months, at the time of retest. All children attended the school continuously during the interval between tests.

Some of the children given Stanford-Binet tests during nursery-school attendance were retested again after withdrawal from our

¹Throughout this study the Stanford-Binet test refers to the 1916 Revision.

Nursery School. The interval between the last test during nursery-school attendance and the retest afterward was from 1 year to 8 years, 11 months. The age range at the time of this last test was from 5 years, 1 month, to 13 years, 1 month.

The interval between tests and the length of nursery-school attendance were approximately the same for different IQ and percentile levels, with three exceptions. With the exception of the level below 90 IQ, the mean intervals between tests for the Stanford-Binet group (Table I) ranged from 13.18 to 15.75 months (S.D.'s 4.56 to 7.11); and the mean days' attendance in nursery school ranged from 142.0

TABLE I.—INTERVAL BETWEEN TESTS AND NUMBER OF DAYS' ATTENDANCE, BY IQ LEVELS, FOR 103 CHILDREN GIVEN STANFORD-BINET TESTS DURING NURSERY-SCHOOL ATTENDANCE

<i>IQ Level</i>	<i>N</i>	<i>Months between Tests</i>		<i>Attendance, in Days</i>	
		<i>M</i>	<i>S. D.</i>	<i>M</i>	<i>S. D.</i>
Below 90	4	8.80	2.28	86.8	24.5
90 to 99	13	13.61	7.11	165.2	88.4
100 to 109	16	14.38	5.24	142.0	42.7
110 to 119	25	15.12	5.68	159.8	73.4
120 to 129	22	13.18	4.56	149.5	57.2
130 to 139	15	15.27	6.88	168.5	66.4
140 and above	8	15.75	5.62	171.8	79.8

to 171.8 (S.D.'s 42.4 to 88.4). The below-90 IQ level had a mean interval between tests of 8.8 months (S.D. 2.28) and a mean days' attendance of 86.8 days (S.D. 24.5). With the exception of the level above 130 IQ, the mean interval between tests for the Merrill-Palmer group, analyzed according to IQ levels (Table II), ranged from 20.7 to 23.4 months (S.D.'s 5.98 to 9.78); and the mean days' attendance in nursery school ranged from 203.7 to 241.3 (S.D.'s 76.0 to 108.6). The level above 130 IQ had a mean interval between tests of 16.0 months (S.D. 6.0) and a mean days' attendance of 151.0 days (S.D. 26.0). With the exception of the 5th to the 19th percentile level, the mean intervals between tests for the Merrill-Palmer group, analyzed according to percentile levels (Table III), ranged from 20.84 to 24.63 months (S.D.'s 2.0 to 9.0), and the mean days' attendance in nursery

school ranged from 203.6 to 248.8 days (S.D.'s 67.0 to 97.0). The 5th to 19th percentile level had a mean interval between tests of 16.33 months (S.D. 7.14), and a mean days' attendance of 114.3 days (S.D. 36.1).

TABLE II.—INTERVAL BETWEEN TESTS AND NUMBER OF DAYS' ATTENDANCE AT NURSERY SCHOOL, BY IQ LEVELS, FOR 107 CHILDREN GIVEN MERRILL-PALMER TESTS DURING NURSERY-SCHOOL ATTENDANCE

<i>IQ Level</i>	<i>N</i>	<i>Months between Tests</i>		<i>Attendance, in Days</i>	
		<i>M</i>	<i>S. D.</i>	<i>M</i>	<i>S. D.</i>
Below 90	6	21.80	5.98	203.7	76.2
90 to 99	27	20.74	7.50	204.1	100.8
100 to 109	38	22.58	7.98	241.3	89.1
110 to 119	23	21.00	8.10	210.5	76.0
120 to 129	11	23.40	9.78	222.6	108.6
130 and above	2	16.00	6.00	151.0	26.0

For the Stanford-Binet group, which was tested after withdrawal from nursery school as well as during nursery school (Table IV), the mean intervals between tests and the mean days' attendance in nursery school are approximately the same at all IQ levels. The mean days'

TABLE III.—INTERVAL BETWEEN TESTS AND NUMBER OF DAYS' ATTENDANCE AT NURSERY SCHOOL, BY PERCENTILE LEVELS, FOR 107 CHILDREN GIVEN MERRILL-PALMER TESTS DURING NURSERY-SCHOOL ATTENDANCE

<i>Percentile Level</i>	<i>N</i>	<i>Months between Tests</i>		<i>Attendance, in Days</i>	
		<i>M</i>	<i>S. D.</i>	<i>M</i>	<i>S. D.</i>
1 to 4	2	23.00	2.00	216.0	67.0
5 to 19	3	16.33	7.14	114.3	36.1
20 to 49	32	21.50	6.62	219.6	83.0
50 to 79	33	22.30	8.40	232.1	90.8
80 to 94	26	20.84	8.54	203.6	93.2
95 to 99+	11	24.63	9.00	248.8	97.0

attendance in nursery school ranged from 142.1 to 180.2 (S.D. 43.8 to 95.2). The mean intervals between tests for this group ranged during nursery school from 13.0 to 16.0 months (S.D. 4.50 to 7.14); and the mean intervals between the final nursery-school test and the test after

withdrawal ranged from 38.9 to 54.45 months (S.D. 15.0 to 25.8). The three exceptions mentioned in each case apply to levels for which the number of cases is very small, from two to four. Nowhere in the analysis of the results is there a divergence from the general trends ob-

TABLE IV.—INTERVAL BETWEEN TESTS AND NUMBER OF DAYS' ATTENDANCE AT NURSERY SCHOOL BY IQ LEVELS FOR 64 CHILDREN GIVEN STANFORD-BINET TESTS BOTH DURING AND AFTER NURSERY-SCHOOL ATTENDANCE

IQ Level	Children	Interval, Months				Attendance, in Days	
		Between First and Last Nursery- School Tests		Between Last Nursery-School Test and Test after Nursery School			
		M	S. D.	M	S. D.	M	S. D.
		90 to 99	10	14.50	6.19	38.90	20.60	180.20	95.2
100 to 109	11	14.00	4.50	54.09	19.75	142.10	43.8
110 to 119	20	14.75	5.90	54.45	25.80	162.45	75.8
120 to 129	13	13.00	4.83	49.00	22.00	144.60	57.8
130 to 139	10	16.00	7.14	46.60	15.00	167.90	51.2

served that might be explained by a shorter interval between tests or fewer days' nursery-school attendance. Accordingly, these exceptions are unimportant.

The large standard deviations for the mean days of nursery-school attendance indicate a large scattering at each level. An analysis according to length of nursery-school attendance, discussed later, shows that IQ changes for groups attending nursery school a small number of days do not differ from the IQ changes for groups attending a larger number of days. It is assumed, therefore, that the wide scattering does not affect the results.

The lack of a control group of non-nursery-school children in this study is regrettable. The data were obtained from the records of the testing program in the Merrill-Palmer School. Although many non-nursery-school children have been tested through the consultation and advisory services of the school, no regular program for testing non-nursery-school children has been maintained. However, the results of

retests on nursery-school children are presented as an indication of IQ changes that occur during attendance in the Merrill-Palmer nursery school. No comparisons, of course, can be made between nursery-school and non-nursery-school children.

V. RESULTS OF RETESTS ON STANFORD-BINET AND MERRILL-PALMER SCALES DURING NURSERY-SCHOOL ATTENDANCE

Wellman¹ studied the IQ changes occurring in nursery school as measured by retests on the Stanford-Binet scale. The mean IQ for the Iowa children upon entering nursery school ranged from 108.2 to 116.5, for different age groups, indicating a tendency for the group to be composed of children somewhat superior mentally. Retests on this group showed marked increases in IQ. The greater gains were made by children of lower IQ levels and the lesser gains by children of higher IQ levels (the levels were determined by their initial tests in nursery school).

The present study concerns the IQ and percentile changes occurring in our Nursery School as measured by retests on both the Stanford-Binet and the Merrill-Palmer scales. The mean Stanford IQ for the children at entrance was 116.9, indicating a group of children of somewhat superior mentality. In this respect, the children studied by Wellman and those of the present study are comparable. However, according to the Merrill-Palmer scale the mean IQ upon entrance to nursery school was 105.2. A partial explanation for the discrepancy between the results on initial Merrill-Palmer tests and initial Stanford-Binet tests might be that the 1916 Revision of the Stanford-Binet test tended to give high IQ's at the lower ages. Only 22 percent of the children comprising the group given the Merrill-Palmer tests are in the Stanford-Binet group.

The average age at the time of the initial test was 31.1 months for the Merrill-Palmer group, and 41.2 months for the Stanford-Binet group. This difference in average age does not account for the difference obtained in initial IQ, because the older and younger children in either study have approximately the same average initial IQ, and in both groups the children are those who were tested during a short interval before or after entrance to the Nursery School.

¹B. L. Wellman. "The effect of preschool attendance upon the IQ." *Jour. Exper. Educ.*, 1: 1932-1933, 48-69.

For the Stanford-Binet group (103 cases), retest results show gains at the lower IQ levels and losses at the higher IQ levels. Figure I and Table V present these data. A point of zero change, above which losses exceed gains and below which gains exceed losses, was graphically determined as 132 IQ. The below-90 IQ group gained an average of 18.8 IQ points. At each IQ level above this, progressively fewer points were gained, until, at the 130 to 139 IQ level, 1.7 IQ points were lost. Above this point the average loss became greater.

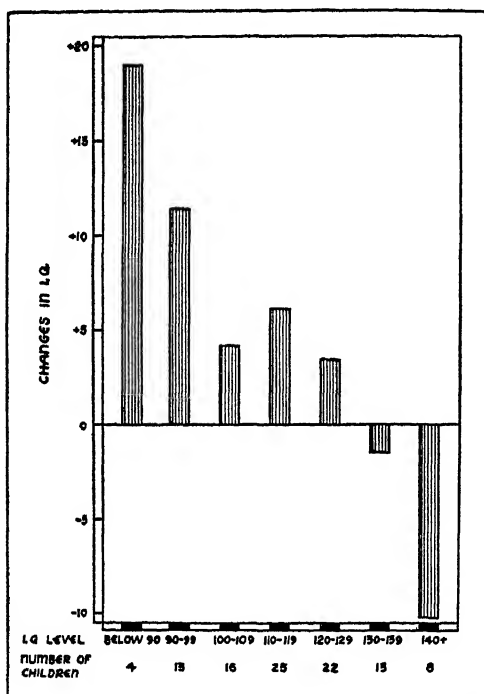


FIG. I.—CHANGES BY IQ LEVELS ON STANFORD-BINET TESTS GIVEN DURING NURSERY-SCHOOL ATTENDANCE

These changes tend to bring the extremes on the first test toward the average of the group on the second test; and at the same time each subgroup (or IQ level) has maintained its relative position. The subgroup above 140 IQ had an initial IQ of 147.6. At the time of retest it had dropped to 137.3 IQ; but this subgroup was still the most

superior. The subgroup below 90 IQ had an initial IQ of 86. This IQ had increased to 104.8 by the time of retest; and this subgroup, although having an average IQ (between 90 and 109), was still the lowest subgroup.

TABLE V.—IQ CHANGES DURING NURSERY-SCHOOL ATTENDANCE FOR 103 CHILDREN GIVEN STANFORD-BINET TESTS

IQ	N	IQ on Initial Test		IQ on Final Test		IQ Change		Crit. Ratio
		M	S. D.	M	S. D.	M	S. D.	
Below 90	4	86.0	1.87	104.8	9.11	18.8	11.05	
90 to 99	13	94.8	2.56	106.3	15.54	11.5	15.72	6.44
100 to 109	16	104.5	2.73	108.8	9.87	4.3	9.36	1.68
110 to 119	25	114.8	3.07	121.4	10.14	6.6	10.62	3.11
120 to 129	22	124.5	2.77	128.2	11.36	3.7	10.20	1.48
130 to 139	15	133.5	2.13	131.8	15.44	— 1.7	15.76	0.42
140 and above	8	147.6	6.42	137.3	11.07	— 10.3	15.12	4.25

Losses indicated by Stanford-Binet retests are statistically significant at the above-140 IQ level, and gains are significant at the 90-99 and 110-119 IQ levels. Critical ratios indicating the significance of

TABLE VI.—IQ CHANGES DURING NURSERY-SCHOOL ATTENDANCE FOR 107 CHILDREN GIVEN MERRILL-PALMER TESTS

IQ Level	N	IQ on Initial Test		IQ on Final Test		IQ Change		Crit. Ratio
		M	S. D.	M	S. D.	M	S. D.	
Below 90	6	82.5	4.57	102.7	17.82	20.2	15.57	
90 to 99	27	93.3	2.05	114.0	9.10	20.7	9.74	13.70
100 to 109	38	104.3	3.15	126.1	12.12	21.8	12.21	10.79
110 to 119	23	114.3	3.08	130.2	11.76	15.9	12.51	6.83
120 to 129	11	123.7	2.77	135.6	9.92	11.9	12.09	8.56
130 and above	2	145.0	3.00	137.5	7.50	— 7.5	10.50	

these changes range from 3.11 to 6.44. In this analysis, the results of the other subgroups, those which showed small changes or few cases, are of importance in that they fit into the general trend of gains at the

lower levels, becoming progressively smaller at the higher levels until losses become apparent.

The results of retests on the Merrill-Palmer scale (107 cases) indicate a trend of changes similar to the trend obtained for the Stanford-Binet group. The results were analyzed according to IQ changes

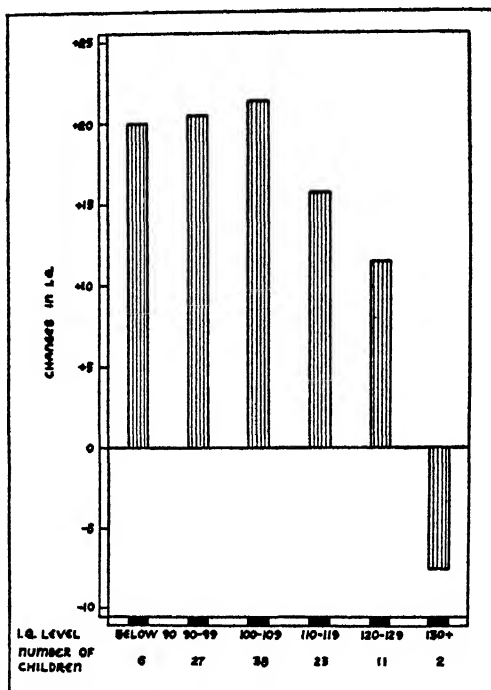


FIG. II.—CHANGES BY IQ LEVELS ON MERRILL-PALMER TESTS GIVEN DURING NURSERY-SCHOOL ATTENDANCE

(Figure II, Table VI) and according to percentile changes (Figure III, Table VII). In both analyses, gains occur at the lower levels and losses at the higher levels; the point of zero change is 137 IQ, or at the 93rd percentile.

These changes also tend to bring the extremes on the first test toward the average of the group on the second test. The most superior subgroups gained less or lost in IQ or percentile, while the lowest subgroups gained larger amounts, as shown by the retests. In spite of changes in IQ and percentile, subgroups have maintained their relative positions. The subgroup having the highest initial IQ still had the

highest at the time of retest, despite slight losses, and the subgroup having the lowest initial IQ still had the lowest at the time of retest. With one exception, this tendency held for the percentile analysis. The two lowest percentile subgroups were still the two lowest at the time of retest, but their positions in relation to each other were reversed.

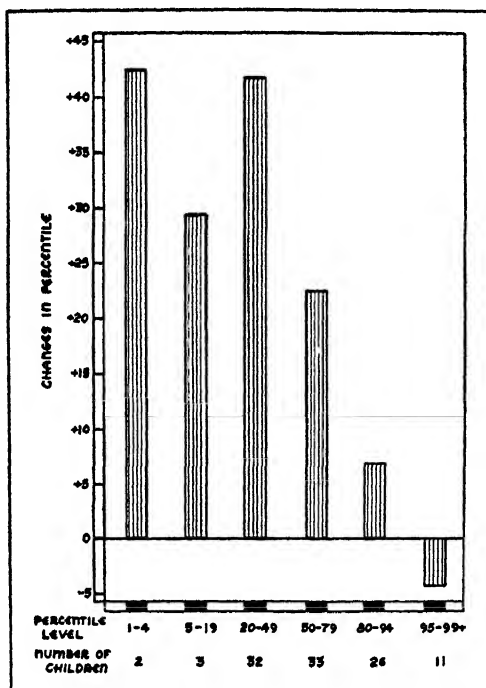


FIG. III.—CHANGES BY PERCENTILE LEVELS ON MERRILL-PALMER TESTS GIVEN DURING NURSERY-SCHOOL ATTENDANCE

In these two subgroups combined there were only five cases. Had there been more, their relative positions might possibly have been maintained, as were the positions of other subgroups in the IQ analysis of both the Merrill-Palmer and Stanford-Binet retests.

IQ and percentile changes indicated by Merrill-Palmer retests are statistically significant for subgroups from 90 to 129 IQ and from the 20th to the 94th percentile. Critical ratios indicating the significance of these changes range from 3.47 to 14.71. Though the changes are

not significant in themselves, the results of the other subgroups are of importance in that they fit into a definite trend of gains at the lower levels and losses at the higher levels.

In so far as the analysis is similar to that of Wellman, the results of this study parallel those obtained by her. Increases in IQ occurred during nursery-school attendance. The greatest gains were made by children in the lower IQ levels and the least gains or losses were made by children in the higher IQ levels, as determined by initial nursery-school tests.

An analysis of the point of zero change seems to indicate that the mental level of the group represented by the mean IQ for the group at the time of entrance to the Nursery School is one of a number of factors

TABLE VII.—PERCENTILE CHANGES DURING NURSERY-SCHOOL ATTENDANCE FOR 107 CHILDREN GIVEN MERRILL-PALMER TESTS

<i>Percentile Level</i>	<i>N</i>	<i>Percentile on Initial Test</i>		<i>Percentile on Final Test</i>		<i>Percentile Change</i>		<i>Crit. Ratio</i>
		<i>M</i>	<i>S. D.</i>	<i>M</i>	<i>S. D.</i>	<i>M</i>	<i>S. D.</i>	
1 to 4	2	4.0	0.00	47.5	32.50	43.5	32.50	
5 to 19	3	13.0	4.16	42.3	27.77	29.3	25.77	
20 to 49	32	32.4	7.74	74.9	13.95	42.5	14.40	14.71
50 to 79	33	65.5	9.08	87.8	12.21	22.3	13.92	8.42
80 to 94	26	85.8	3.96	92.7	9.40	6.9	10.40	3.47
95 to 99+	11	97.2	1.59	92.8	6.94	— 4.4	7.98	0.42

affecting the direction and amount of IQ change. The children studied did not attend nursery school at the same time. Therefore the mean IQ upon entrance to nursery school is not necessarily the mental level of the children in nursery school at any given time, but rather is representative of the mental level of the changing group of children attending nursery school over a period of years. The point of zero change is the point above which there are losses and below which there are gains. The mental level of the group on the initial test was 116.9 IQ (Stanford-Binet) and 105.2 IQ (Merrill-Palmer), and the point of zero change was 132 IQ (Stanford-Binet) and 137 IQ (Merrill-Palmer), showing differences of 15 to 32 IQ points between the group mental level and the point of zero change. Were the group mental level the main factor

influencing IQ change, it would necessarily be similar to the point of zero change. The present study shows them to be widely separated, indicating that there must be major factors other than group mental level affecting IQ change. Similar results have been obtained in Iowa studies of elementary-school children.

VI. COMPARISON OF WOOLLEY'S STUDY WITH THE PRESENT STUDY

One of the first studies concerning the effect of nursery-school attendance on the IQ was presented by Woolley¹ in 1925. By comparing Merrill-Palmer Nursery School children with Merrill-Palmer waiting-list children, both groups being tested twice on the Stanford-Binet scale, she found that the nursery-school children gained in IQ more often and more substantially than did the waiting-list children, while for the latter the frequency of gains and losses was the same, and the losses were larger than the gains. The gains of the nursery-school children, she believed, were caused by the increased "opportunities to learn" in the nursery-school environment.

	<i>Number</i>	<i>Percent</i>	<i>Mean IQ Change</i>
Woolley: Nursery-School Children			
Increase	27	63	19.7
Decrease	8	18.5	10.8
Constant	8	18.5	
Woolley: Waiting-List Children			
Increase	12	33	12.7
Decrease	13	36	16.2
Constant	11	31	
Present Study: Nursery-School Children			
Increase	62	60	13.0
Decrease	35	34	10.4
Constant	6	6	

The results of the Stanford-Binet retests in the Nursery School considered in the present study parallel those obtained by Woolley.

¹H. T. Woolley. "The validity of standards of mental measurement in young childhood." *School and Soc.*, 21: 1925, 1-7. (April 18)

Of Woolley's cases, 63 percent gained an average of 19.7 IQ points, and 18.5 percent lost an average of 10.8 IQ points. In the present study, 60 percent gained an average of 14.1 IQ points, and 34 percent lost an average of 10.4 IQ points. These results are compared with those obtained by retesting waiting-list children. Woolley found that of these children who had not attended nursery school, 33 percent gained an average of 12.7 IQ points, and 36 percent lost an average of 16.2 IQ points.

In both studies large gains occurred more frequently than large losses for the nursery-school children. In Woolley's study 33 percent gained 20 IQ points or more, and 10 percent lost this amount. In the present study 12 percent gained and 6 percent lost amounts of 20 IQ points or more. For the waiting-list group, the trend was reversed; there were more large losses than gains; 20 IQ points or more were gained by 6 percent and lost by 16 percent of the children. The following tabulation gives the percentage of cases in both studies in which there was a change of 20 or more IQ points.

	<i>Woolley Study Nursery-School Children</i>	<i>Present Study Nursery-School Children</i>	<i>Woolley Study Waiting-List Children</i>
Gains	33	12	6
Losses	10	6	16

The results of the present study parallel those obtained by Woolley. Both studies are concerned with Merrill-Palmer Nursery School children, and both studies indicate that gains in IQ determined by retests on the Stanford-Binet scale are associated with nursery-school attendance.

VII. NUMBER OF DAYS' ATTENDANCE AND IQ CHANGES

An analysis of the results according to the number of days' attendance in our Nursery School indicated no difference between IQ changes of those children who attended for a small number of days and those who attended for a larger number of days (Tables VIII and IX). All children were enrolled in the Nursery School continuously during the interval between their tests, which ranged from 6 to 40 months.

There is a consistent trend of changes observed in the analysis by IQ and percentile levels. The average subgroups (90 to 109 IQ; 20th

TABLE VIII.—EFFECT OF NUMBER OF DAYS' ATTENDANCE ON MEAN IQ AND MEAN PERCENTILE CHANGES FOR CHILDREN GIVEN THE MERRILL-PALMER TEST

IQ Level	Number of Days' Attendance							
	50 to 149		150 to 249		250 to 349		350+	
	Chil- dren	IQ Change	Chil- dren	IQ Change	Chil- dren	IQ Change	Chil- dren	IQ Change
Below 90	2	24.5	2	18.5	2	17.5	0	
90 to 109	14	21.4	26	23.3	18	17.3	7	24.6
110 and above	12	13.8	11	19.2	10	6.9	3	12.0
Percentile Group	Per- centile Change		Per- centile Change		Per- centile Change		Per- centile Change	
	Chil- dren	IQ Change	Chil- dren	IQ Change	Chil- dren	IQ Change	Chil- dren	IQ Change
	Chil- dren	IQ Change	Chil- dren	IQ Change	Chil- dren	IQ Change	Chil- dren	IQ Change
Below 20	4	55.8	1	7.0	1	11.0	0	
20 to 79	12	37.5	28	32.1	17	28.6	7	32.4
80 and above	12	5.2	10	7.9	12	- 2.5	3	6.7

to 79th percentile) in almost every instance have gained amounts greater than those of the superior subgroups (above 110 IQ; above 80th percentile). The number of cases for any one subgroup is small;

TABLE IX.—EFFECT OF NUMBER OF DAYS' ATTENDANCE ON MEAN IQ CHANGES FOR CHILDREN GIVEN THE STANFORD-BINET TEST

IQ Level	Number of Days' Attendance					
	50 to 124		125 to 199		200+	
	Chil- dren	IQ Change	Chil- dren	IQ Change	Chil- dren	IQ Change
90 to 109	12	5.2	10	10.5	7	7.7
110 to 129	20	6.9	13	0.2	15	5.7
130 and above	7	-10.2	7	7.8	8	-7.9

but these findings are in keeping with the results of retests of larger groups, which show a trend of gains at lower levels progressively becoming smaller until losses become apparent at the higher levels. This

close relationship enhances the importance of the results obtained from these few cases.

In no instance is there a consistent trend of changes observed in the analysis by number of days of nursery-school attendance. Changes occurring after short attendance seem not to differ from those occurring after long attendance. The results indicate that, given an adequate number of cases, the results might still show no differences between IQ or percentile changes after long and short nursery-school attendance. An analysis with a large number of cases must be made before this indication can be substantiated.

Wellman¹ analyzed IQ changes according to the number of days' attendance in nursery school between tests. According to Merrill-Palmer test results, Iowa children attending 40 to 79 days had greater gains than those attending 80 to 119 days. On Stanford-Binet tests, the reverse was true. Greater gains were associated with longer attendance.

VIII. IQ CHANGES AFTER WITHDRAWAL FROM THE NURSERY SCHOOL

The question of the permanence of IQ changes was raised by Woolley² in her study of the effect of nursery-school attendance on the IQ. She reported results on 18 cases retested on the Stanford-Binet scale after they had left nursery school. Of these, 8 increased and 8 decreased in IQ, and 2 remained constant. The amounts lost and gained balanced. The tendency for this small group, then, was to maintain the gains acquired during nursery-school attendance. These results are based on few cases, but the tendency seems to be confirmed by later studies.

Wellman³ showed that gains were made by children attending the preschool laboratories and elementary schools of the State University of Iowa, and that, after transfer to other schools, these gains were maintained, though not augmented, over a period of 4 to 8 years.

¹B. L. Wellman. *The Intelligence of Preschool Children as Measured by the Merrill-Palmer Scale of Performance Tests*. (University of Iowa Studies in Child Welfare Vol. 15, No. 3: Iowa City, 1938), 150 pp.

²H. T. Woolley, *Op. cit.*

³Wellman, B. L. "Growth of intelligence under differing school environments." *Jour. Exper. Educ.*, 3: 1934-1935, 59-83.

Retests of Merrill-Palmer children with the Stanford-Binet after leaving nursery school have been analyzed as Wellman analyzed her data. Table X gives comparative data for the Wellman and Merrill-Palmer studies. The children in both studies are grouped according to IQ levels as represented by the initial nursery-school test; and from this grouping the changes occurring during attendance in the University of Iowa Schools and the Merrill-Palmer Nursery School have

TABLE X.—COMPARISON BETWEEN WELLMAN AND MERRILL-PALMER STUDIES OF MEAN IQ CHANGES DURING AND AFTER NURSERY-SCHOOL ATTENDANCE FOR CHILDREN GIVEN STANFORD-BINET TESTS

<i>IQ Level</i>	<i>During Nursery-School</i>		<i>After Nursery-School</i>	
	<i>N</i>	<i>IQ Change</i>	<i>N</i>	<i>IQ Change</i>
Wellman Study				
70 to 89	6	14.4	5	14.8
90 to 109	31	12.6	12	1.8
110 to 119	7	9.7	16	4.8
120 to 139	13	4.4	22	— 5.0
140 to 159	4	— 3.3	6	— 1.0
70 to 159	61	8.6	61	1.1
Merrill-Palmer Study				
80 to 89	3	23.0	2	9.0
90 to 109	21	6.1	14	10.2
110 to 119	20	5.9	22	0.3
120 to 139	23	1.2	27	— 0.5
140 to 159	5	—15.8	7	—10.1
80 to 159	72	5.5	72	1.2

been determined. Both studies show large gains at the lower IQ levels, progressively becoming smaller, until at the 140 to 159 IQ level, losses become apparent. The average change for the whole group is a gain in both studies; the gain in Wellman's study was 8.6 IQ points; that in the present study, 5.5 IQ points.

To determine whether these changes were maintained, the same children were regrouped according to IQ levels as determined by the test given at the end of continuous enrollment in the two school systems.

From this grouping the changes occurring after withdrawal were determined. The results showed that neither Wellman's group nor the Merrill-Palmer Nursery-School group as a whole changed significantly in IQ. In Wellman's study the 70 to 89 IQ subgroup gained 14.8 IQ points; and the other subgroups remained within 5 points of the original IQ. The lower IQ levels show slight gains, and the higher IQ levels slight losses, but there is no definite trend. In the present study a trend from gains at the lower levels to losses at the higher levels is evident. The difference between this trend and that for changes occurring during nursery-school attendance is that the transition from gains to losses does not occur at the same IQ level in both instances. During nursery-school attendance gains occurred only for those levels below 120 IQ.

The regrouping of cases according to the last nursery-school test is a means of obtaining from the general population a group of children who have had nursery-school training. Research has indicated that in the general population high IQ's tend to decrease and low IQ's to increase. Therefore, retests on a sampling from the general population would be expected to show changes directed toward 100 IQ as the point of zero change. If the children retested after withdrawal from the nursery school assume their new IQ positions in relation to the general population (that is, if they maintain the gains in IQ they acquired during nursery-school attendance), their future IQ changes should be similar to those that are expected according to the trend of changes in the general population. Changes after nursery-school attendance, in this case, should be directed toward 100 IQ. If these children do not assume their new IQ positions, the after-nursery-school changes should exhibit a trend similar to that of the general population, but with a lower point of zero change to compensate for the spurious gains.

In the present study, the point of zero change is in the 110 to 119 IQ level. This point of zero change is somewhat higher than that for the general population. The indication is, then, that gains acquired during nursery-school attendance are maintained after withdrawal from nursery school. In Wellman's study the changes occurring after withdrawal from the University schools indicate no definite trend, but the slight changes do indicate a tendency for gains to occur at levels below 120 IQ and losses to occur above this level. In view of these facts as well as the smallness of the IQ changes, the evidence

indicates that gains acquired in the nursery school are maintained after withdrawal from it.

A second analysis to determine the permanence of IQ changes was applied to the results of the present study. In order to determine whether the cases at any one IQ level maintained the gains made during nursery-school attendance, the cases were kept in IQ groupings

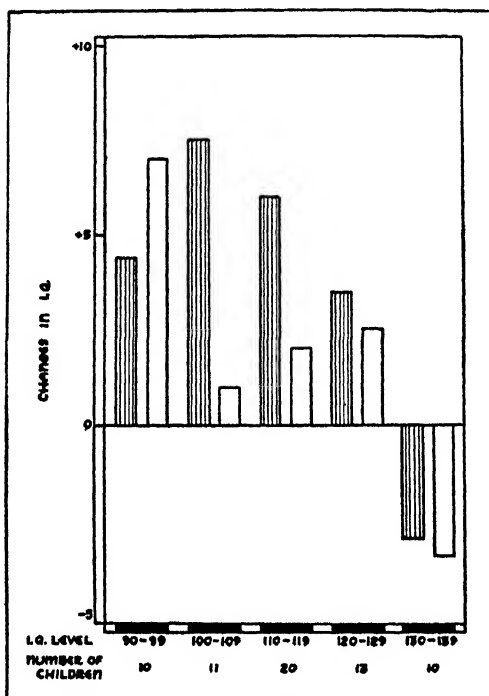


FIG. IV.—CHANGES BY IQ LEVELS ON STANFORD-BINET TESTS GIVEN DURING (SHADED COLUMN) AND AFTER (UNSHADED COLUMN) NURSERY-SCHOOL ATTENDANCE

according to initial nursery-school tests for the analysis of changes occurring after withdrawal from nursery school.

Table XI and Figure IV show that the changes occurring during nursery-school attendance indicate a trend of gains at the lower IQ levels progressively becoming smaller until, at the 130 to 139 IQ level, losses become apparent. The 7.4 IQ gain at the 100 to 109 IQ level is significant (critical ratio, 4.97) and the 5.9 IQ gain at the

TABLE XI.—IQ CHANGES DURING AND AFTER NURSERY-SCHOOL ATTENDANCE FOR CHILDREN GIVEN
THE STANFORD-BINET TEST

IQ Level	N	IQ on In- ital Nur.- Sch. Test		IQ on Final Nur.- Sch. Test		IQ Change during Nur.-Sch. Attendance		IQ on after Nur.- Sch. Test		IQ Change after Nur.-Sch. Attendance		Crit. Ratio	
		M	S.D.	M	S.D.	M	S.D.	M	S.D.	M	S.D.	M	S.D.
90 to 99	10	95.0	2.53	99.6	9.48	4.6	5.15	106.7	9.46	7.1	8.48	1.59	1.59
100 to 109	11	104.4	2.73	111.8	10.70	7.4	8.60	112.8	13.77	1.0	11.01	0.43	0.43
110 to 119	20	114.9	2.64	120.8	10.80	5.9	11.34	122.8	13.24	2.0	11.01	0.52	0.52
120 to 129	13	124.5	3.48	127.9	12.72	3.4	10.47	130.4	18.16	2.5	12.27	0.39	0.39
130 to 139	10	132.6	3.60	129.7	13.56	-2.9	14.13	126.0	7.62	-3.7	16.23	0.71	0.71

110 to 119 IQ level approaches significance (critical ratio, 2.37). Changes at other IQ levels lack statistical significance, but the trend is definite, and the smaller IQ changes are therefore of greater importance than they appear to be when considered separately.

The changes occurring after withdrawal from the nursery school indicate no trend whatsoever (Table XI, Figure IV); and at no IQ level does the change approach significance. In view of the trend in changes occurring during nursery-school attendance and the lack of such a trend in those occurring after withdrawal, and the lack of significance of changes at any one IQ level after withdrawal, it seems justifiable to conclude that changes occurring during nursery-school attendance are maintained after withdrawal. Of the two IQ levels that showed significant, or nearly significant, gains during nursery-school attendance (100 to 109 and 110 to 119 IQ levels), neither shows a gain of any significance after withdrawal. This finding tends to substantiate the conclusion that IQ changes occurring during nursery-school attendance are permanent.

IX. SUMMARY OF RESULTS

Merrill-Palmer tests were given to 107 children and Stanford-Binet tests to 103 children upon entrance to the Merrill-Palmer Nursery School. These children were reëxamined on the same tests after an interval of 6 to 40 months while still enrolled in the Nursery School. Of the Stanford-Binet group, 72 were retested one year to 8 years, 11 months, after withdrawal from nursery school.

Analysis of these data resulted in the following findings:

1. Children attending the Merrill-Palmer Nursery School gain in IQ and percentile as measured by Stanford-Binet and Merrill-Palmer retests.
2. An inverse relationship exists between initial IQ or initial percentile levels and IQ gains or percentile gains.
3. Varying lengths of nursery-school attendance show no relationship to IQ or to percentile changes.
4. The results of retests following withdrawal from the nursery school indicate that IQ changes occurring during nursery-school attendance are real; that is, they tend to be maintained after withdrawal.
5. This study, using methods of analysis comparable to Wellman's, agrees with her findings on the relation between nursery-school attendance and IQ changes.

CHAPTER XXIII

THE MENTAL DEVELOPMENT OF CHILDREN OF FEEBLE-MINDED MOTHERS: A PRELIMINARY REPORT¹

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This chapter is a preliminary report on an attempt to follow the mental development of children born of feeble-minded mothers who have been reared apart from their parents. The children were all permanently separated from their true mothers before their first birthday and have lived since that time in boarding homes, nurseries, or orphanages.

I. CRITERIA FOR SELECTION OF TWO GROUPS OF CHILDREN

Because of child placement policies in Minnesota, children of mothers of questionable intelligence are not allowed to be placed for adoption until old enough to have had one or more reliable mental tests. Hence the homes in which the children were first placed were not adoptive homes. Some children have remained in the same boarding homes since infancy. Twelve of the children have since been adopted, but since the state testing service usually does not continue to follow a child after his adoption, the study reported in this chapter is based on the development of the children during their stay in boarding homes.

The children used for the study were selected on three criteria:

- (1) Placement in a boarding home or institution before one year of age.
- (2) A mental-test record including at least one test given when the child was two and one-half years or older.
- (3) Freedom from disease or serious physical defect.

¹ The present study includes only data on children of girls committed as feeble-minded in Hennepin County and is a part of a larger study now under way which will include children of feeble-minded mothers from the entire state of Minnesota. It is estimated that case records on 200 or more children will be available for the larger study.

On the basis of these criteria two groups were selected. The first (or Experimental Group) was composed of 48 children whose mothers had been judged feeble-minded by the State Board of Control; the second (or Control Group) was composed of 29 children whose mothers were of normal intelligence when judged on the basis of educational achievement, work record, or intelligence tests. All children were white and non-Jewish. All the Control, and all but three of the Experimental, Group were illegitimate.

Although the children of the first group were largely wards of the state or county, those of the second group were supported by their mothers, because it has been a policy to encourage normal girls to retain guardianship and support of their children until they reach an age at which their mental status can be reliably ascertained. The boarding homes did not differ in character for the two groups (see Table II). Placements for both groups were made through private and county agencies in homes certified by the State Board of Control. In some cases the same homes have been used for children of both Control and Experimental Groups.

All data were obtained from case records. The Experimental Group was selected from the files of the Feeble-minded Division of the State Board of Control and includes all the children who met the criteria and whose mothers had been committed as feeble-minded to the State Board of Control from Hennepin County, in which Minneapolis is located. The Control Group was obtained from the files of the various welfare agencies of the Twin Cities.

II. THE CHILDREN THEMSELVES

Of the Experimental Group 29 were boys; 19 girls. At the time of their last mental test the children ranged from $2\frac{1}{2}$ to 13 years of age, (median, 5 years). A total of 149 mental tests had been given these children after they were a year old. The individual children had been placed in from 1 to 8 different homes or institutions; in all there were 130 home, and 20 institutional (orphanage, hospital nursery, or school for feeble-minded), placements. The mean number of home and of institutional placements per child was 2.29 and .42, respectively.

Of the Control Group, 16 were boys; 13 girls. At the time of their last test these children ranged from $2\frac{1}{2}$ to 11 years (median, 3 years, 9 months). The number of home or institutional placements for this

group ranged from 1 to 9; in all, there had been 61 home and 13 institutional placements. The average was 2.10 home and .44 institutional placements per child.

III. THE MOTHERS OF THE CHILDREN

All the mothers of the Experimental Group had been given one or more mental tests, except a single case that had been judged feeble-minded by competent physicians. All had been committed to the State Board of Control as feeble-minded, and all but 8 had spent some time in one of the state institutions for the mentally defective. A total of 62 tests had been given to these women (28, the 1916 Revision of the Stanford-Binet; 27, the Kuhlmann-Binet; and 19, unspecified tests administered by the Board of Education during the school attendance of the mother). The range of the test scores was 32 to 77 on the Stanford; 40 to 69 on Kuhlmann; and 48 to 71 on the other tests. The median IQ's for these tests were 63, 60, and 61, respectively. The testing was done by competent examiners (Kuhlmann-Binet, by the highly-trained staff of the State Research Bureau; the Stanford-Binet and other tests, by persons well trained in testing).

The testing was usually not done near the time of the mother's confinement. It is a well-recognized assumption that tests made at this time may be spuriously low due to emotional strain. Twelve of the mothers were tested within 3 months of the birth of the child, and of these, 4 had had one or more other tests. The test given closest to the time of a child's birth was given to one mother 9 days after the birth of her child. This mother was later given 2 additional tests.

Educational information, available for 44 mothers in the Experimental Group, showed a range from Grade II to Grade IX, median Grade VI. Seven of the group had attended special classes.

On the basis of intelligence ratings and educational achievement, the mothers in this group average somewhat inferior to the group of 'feeble-minded' mothers studied by Skodak,¹ who had an average IQ of 66.4 and an average grade attainment of 7.6. On the basis of their legal status in the state of Minnesota, the mothers of our Experimental Group may be assumed to be truly feeble-minded.

¹ M. Skodak. *Children in Foster Homes: A Study of Mental Development*. (University of Iowa Studies in Child Welfare, Vol. 18, No. 1: Iowa City, 1939), 156 pp.

Of the control mothers, 15 were given Kuhlmann-Binet tests and one unspecified test. Until recently, the testing of mothers of illegitimate children has not been customary unless the intelligence was questioned. Therefore, ratings were not available on the other members of this group. The range of IQ's for those tested was 87 to 175+; the median, 102. If the mothers who were tested may be considered representative of the total group, the control mothers are of normal intelligence. Actually, the tested group is likely to be somewhat inferior to the group as a whole since girls whose ability seemed questionable were more likely to be tested than were those about whom no question arose.

The highest school grade attained was known for 27 mothers of the control group. The median attainment was tenth grade; the range, from Grade VIII to two years in a university or teachers' college. One-fourth of the group graduated from the high school. This may be considered to be average school achievement or better.

In IQ, the groups are distinctly separate; there is no overlapping between them. In the amount of education, the groups are widely separated, although 18 percent of the mothers of the Experimental Group exceeded the lowest grade attainment of the mothers of the Control Group. If intelligence-test rating and educational achievement can be considered to be indicative of hereditary background, the children of the Control Group may be thought to be more promising placement-material than those of the Experimental Group.

IV. THE PUTATIVE FATHERS

Any material obtained on the fathers of illegitimate children must be viewed critically. Even in cases in which paternity has been legally established, information may be inaccurate. Owing to lack of knowledge, to promiscuity, desire to get even with some man, to shield another, or for other reasons, the identity of the true father may not be disclosed. In this study, as in all dealing with this problem, the information obtained is uncertain and unsatisfactory. Even in cases in which a man was named, information about him was often not recorded. There were no data on 29 percent of the Experimental and 24 percent of the Control Group (Table I). Of the cases in which paternity was either established or stated to be relatively certain, the

fathers were classified as shown in Table I. The rating was made by the Minnesota Scale of Occupations.¹

When the uncertainty of the data and the small number of individuals are taken into account, no conclusions can be drawn from these figures. It is unfortunate that more information is not available on the

TABLE I.—DISTRIBUTION OF OCCUPATIONAL STATUS OF THE PUTATIVE FATHERS IN SEVEN OCCUPATIONAL CLASSES

	<i>I and II</i>	<i>III</i>	<i>IV</i>	<i>V</i>	<i>VI</i>	<i>VII</i>	<i>Unknown</i>	<i>No Inf.</i>
Experimental Group								
Number	0	3	1	15	5	9	1	14
Percent	0	6	2	31	11	19	2	29
Control Group								
Number	5	5	0	3	2	4	3	7
Percent	18	18	0	10	7	13	10	24

true fathers of the children, since the differences in intelligence between the Control and Experimental Groups, as well as those within the groups, might be at least partially explained if the paternity were known. From the information obtained, it would seem probable that few if any, of the true fathers were feeble-minded, but this is highly uncertain.

V. THE BOARDING-HOME AND INSTITUTIONAL PLACEMENTS

Boarding homes cannot be considered so favorable an environment as adoptive homes. In most cases children are taken for boarding to supplement the family income. While the children are given excellent physical care, the interest in the child and the attention shown him cannot be compared with that of homes into which the child is actually adopted or is on trial for adoption. However, since analysis of the placements of the children of the two groups indicates that there is no tendency for an agency to place the child of a mother of high intelligence in a better home than that in which the child of a feeble-minded

¹F. L. Goodenough and J. E. Anderson. *Experimental Child Study*. (D. Appleton-Century: New York, 1931) 546 pp.

mother is placed, a comparison between the two groups used in our study is warranted.

In computing these figures any home or institution in which the child stayed more than three months was considered as a placement. The hospital-nursery placements were with one exception first placements. In these cases the child stayed for more than 3 months after birth in the maternity hospital before he was placed in a boarding home.

Children of both the Experimental and the Control Groups tended to have rather checkered home lives. Ten (20.8 percent) of the experimental and eight (27.5 percent) of the control children had been placed in only one home up to the time of the last test. The maximal number of placements was eight for one child in the Experimental Group and nine for one in the Control. Four children of the Experimental and three of the Control Group were placed in seven or more homes. The average number of home placements was 2.29 for the Experimental and 2.10 for the Control Group.

The types of institutions in which the children had lived were children's homes operated by various social or religious organizations, such as Lutheran Children's Friend Society, Receiving Home, a nursery in a maternity hospital, the State Public School, the School for the Feeble-minded, and Home Management House maintained by the home economics department of the University of Minnesota. The three miscellaneous placements listed for the Experimental Group include a girls' club for unmarried mothers in which two children spent the first year of their lives; the third of these cases was a girl who spent the period from 3 years, 3 months, to 4 years, 6 months, in her own home. This child was included since she had had mental tests before this time and was followed afterwards until she was 11 years of age. (See Table II.)

While these homes and institutions are inferior to the average American home, they are probably superior to the homes that the true parents, particularly those of the Experimental Group, would have provided them.

VI. MENTAL DEVELOPMENT OF THE CHILDREN

The testing of these children was largely done by the State Research Bureau. For several reasons the tests made by these examiners may be considered to be relatively free from prejudice. The mothers'

intelligence and the home background of children brought in for tests was not known by the examiners. Because of the large staff of examiners, children were usually tested by different examiners on subsequent occasions.

TABLE II.—NUMBER AND PERCENTAGE OF HOME AND INSTITUTIONAL PLACEMENTS BASED ON MINNESOTA OCCUPATIONAL CLASSIFICATION

<i>Placement</i>	<i>Experimental Group</i>		<i>Control Group</i>	
	<i>Num-ber</i>	<i>Per-cent</i>	<i>Num-ber</i>	<i>Per-cent</i>
Home Placements				
Occupational Classes I and II	13	11.8	7	11.4
Occupational Class III	23	20.9	15	24.6
Occupational Class IV	3	2.7	1	1.6
Occupational Class V	36	32.7	23	37.7
Occupational Class VI	16	14.6	5	8.2
Occupational Class VII	2	1.8	0	0
No Information	17	15.5	10	16.4
Total	110		61	
Institutional Placements				
Children's Homes	10	50	8	61.5
Hospital-nursery	5	25	3	23.1
Home Management House	0	0	2	15.4
School for Feeble-minded	2	10	0	0
Miscellaneous	3	15	0	0
Total	20		13	

Fifteen 1937 Standards were given to children of the Control Group and 5 to children of the Experimental Group by the writer and another examiner from the University of Minnesota. These examiners did not

know the placement background of the child tested and usually did not know to which group the child belonged. The children's records were never checked before the child was tested, and every effort was

TABLE III.—RESULTS OF ALL MENTAL TESTS GIVEN AFTER ONE YEAR

IQ	<i>Experimental Group</i>			<i>Control Group</i>		
	<i>Kuhlmann-Binet</i>	<i>1937 Stanford-Binet</i>	<i>Kuhlmann and Stanford Combined*</i>	<i>Kuhlmann-Binet</i>	<i>1937 Stanford-Binet</i>	<i>Kuhlmann and Stanford Combined*</i>
125 to 129					1	1
120 to 124	1		1		2	2
115 to 119	2	1	3		0	0
110 to 114	6		6	3	3	6
105 to 109	5		5	3	7	10
100 to 104	6		6	6	1	7
95 to 99	6		6	3	0	3
90 to 94	14		14	5	1	6
85 to 89	15	2	17	12		12
80 to 84	28	2	30	3		3
75 to 79	25	3	28	1		1
70 to 74	10		10	1		1
65 to 69	5	2	7	0		0
60 to 64	8		8	1		1
55 to 59	3		3			
50 to 54	0	1	1			
45 to 49	3		3			
40 to 44	1		1			
Number	138	11	145	38	15	53
Mean	83.65	79.77	83.37	93.16	110.5	97.21
S. D.	14.99	15.45	15.33	11.07	8.32	12.49

* The author realizes that combining intelligence-test results from Stanford and Kuhlmann-Binets is a questionable technique, but feels justified in including these figures for comparison with other studies since separate distributions, means, standard deviations, and percentages are also given.

made to avoid prejudgment of the child's ability when administering the tests.

A total of 138 Kuhlmann-Binet and 11 1937 Stanford-Binets were given to the Experimental Group after the children were one year of

age. Thirty-eight Kuhlmann and 15 1937 Stanford-Binet tests were given to the Control Group. The percentages of these tests falling into the various intelligence levels are shown in Table III.

TABLE IV.—DATA OF TABLE III SUMMARIZED FOR FOUR IQ GROUPS

<i>Test</i>	<i>Experimental</i>		<i>Control</i>	
	<i>Num- ber</i>	<i>Percent</i>	<i>Num- ber</i>	<i>Percent</i>
Under 75				
Kuhlmann-Binet	30	20.13	2	3.77
Stanford-Binet	3	2.01	0	0.0
Total*	33	22.14	2	3.77
Under 90				
Kuhlmann-Binet	98	65.77	18	33.96
Stanford-Binet	10	6.71	0	0.0
Total	108	72.48	18	33.96
90 to 100				
Kuhlmann-Binet	20	13.42	7	13.21
Stanford-Binet	0	0.0	2	3.77
Total	20	13.42	9	16.98
Over 100				
Kuhlmann-Binet	20	13.42	13	28.53
Stanford-Binet	1	.67	13	28.53
Total	21	14.09	26	49.06

* On the combinations into totals, see footnote under Table III.

A few tests under one year were not included in this table but were counted in the discussion of the relation of early IQ's to later development.

In the Experimental Group, 38 of the *last* tests given to each child were Kuhlmann-Binets and 10 were 1937 Stanford-Binets. The median age of the children at the time of their last test was 4.5 years. For the 33 children under 6 years who were given Kuhlmann-Binets, the mean I Q was 91.57; for those given Stanford-Binets, it was 80.56.

In the Control Group 13 children were given Kuhlmann-Binets. The mean IQ on these last tests was 95.0; for the 16 children given Stanford-Binets (1937), the mean IQ was 105.99. The median age of children given Kuhlmann-Binets was 6.5; of those given Stanfords, 3.5.

When the earliest tests (those under 2 years) were considered in relation to the later mental development of the children, it was found that, 26 children of the Experimental Group and of 11 children of the Control Group who were given Kuhlmann-Binets, 17 of the Experi-

TABLE V.—RESULTS OF LATEST MENTAL TEST GIVEN EACH CHILD

	<i>Experimental Group</i>			<i>Control Group</i>		
	<i>Kuhlmann-Binet</i>	<i>1937 Stanford-Binet</i>	<i>Kuhlmann and Stanford Combined*</i>	<i>Kuhlmann-Binet</i>	<i>1937 Stanford-Binet</i>	<i>Kuhlmann and Stanford Combined*</i>
120 to 129	1		1		3	3
110 to 119	6	1	7	1	4	5
100 to 109	7		7	3	8	11
90 to 99	6		6	4	1	5
80 to 89	7	5	12	5		5
70 to 79	8	1	9			
60 to 69	2	2	4			
50 to 59	0	1	1			
40 to 49	1		1			
Number	38	10	48	13	16	29
Mean	91.34	80.00	89.38	95.00	110.00	103.63
S. D.	17.00	15.65	12.02	9.61	9.35	11.95

*See footnote under Table III.

mental Group and all 11 of the Control Group improved on later tests; 8 of the Experimental Group showed lower IQ's, and one remained the same. This was determined by comparing the averages of the later with those of the early test, without regard to the magnitude of the change. It is interesting to find this difference in test performance in view of other recent studies in the field which show that children of feeble-minded mothers placed in environments superior to their own will consistently rise. From our data it appears that increases rather than decreases in standing are the rule, even when the homes are of

mediocre character, a fact which suggests that the standardization of the test, rather than a true increase in status may account for the differences obtained. It should also be noted that, while all the children of the Control Group gained upon retest after the age of two years, only 65 percent of the Experimental Group did so. This may be significant in view of the finding of Skodak¹ that children of inferior parentage test lower on later than on earlier tests, even when placed in superior homes. Although, in view of the small number of cases and the unreliability of the tests, no certain conclusions can be reached, our findings suggest that children of feeble-minded mothers are less likely to show gains upon retests than are those of normal mothers, even though the environment may be similar.

At the present time 5 (10.4 percent) of the children of the Experimental Group are in institutions for the feeble-minded. Of these 5, all but one² have spent the majority of their lives in homes that can be classed as Group III or Group V by the Goodenough Occupational Classification.

In order to compare the mental development of children who had been placed in comparable environments, an analysis was made of the children who had been placed only in homes of the Occupational Levels III and V. It was felt justifiable to consider these two types homes as similar since the original division into socioeconomic classes was an arbitrary one and since semiskilled workmen (V) probably have as much education and receive as high, if not higher, salaries than the lower brackets of the white-collar classes (III). The average IQ's of children tested at ages 3, 5, and 6 were computed and Student's *t* test was applied to determine the significance of the difference. Although the groups were very small, reliable differences were found. Table V shows comparisons, first on the basis of Kuhlmann-Binet

¹Skodak, *Op. cit.*, p. 89.

²This one child had been in a club for unmarried mothers until he was 9 months old and was then sent to the State School for the Feeble-minded at Faribault. He was included in the study in spite of the inferior environment because of the decision to include all the children who met the criteria for inclusion in the study. In view of the report by Skeels in Part II, Chapter XX, of this Yearbook the case is particularly interesting. The boy was rated as 'feeble-minded' by physicians at one year and five months; and his IQ on later mental tests was 55 at 1 year, 10 months (Kuhlmann-Binet); 71 at 3 years, 0 months (test not specified), 75 at 10 years, 10 months (Kuhlmann-Binet), 75 at 13 years, 7 months (Kuhlmann-Binet).

tests given to each group at these ages, and then on the basis of Kuhlmann-Binets given to the Experimental, and both Kuhlmann-Binet and 1937 Stanford-Binets given to the Control Group.

TABLE VI.—DATA OF TABLE V SUMMARIZED FOR FOUR IQ GROUPS

<i>Test</i>	<i>Experimental</i>		<i>Control</i>	
	<i>Num- ber</i>	<i>Percent</i>	<i>Num- ber</i>	<i>Percent</i>
Under 75				
Kuhlmann-Binet	6	12.5	0	0
Stanford-Binet	4	8.33	0	0
Total	10	20.83	0	0
Under 90				
Kuhlmann-Binet	18	37.5	5	17.24
Stanford-Binet	9	18.75	0	0.0
Total	27	56.25	5	17.24
90 to 100				
Kuhlmann-Binet	6	12.50	4	13.79
Stanford-Binet	0	0.0	1	3.45
Total	6	12.50	5	17.24
Over 100				
Kuhlmann-Binet	14	29.17	4	13.79
Stanford-Binet	1	2.08	15	51.73
Total	15	31.25	19	65.52

In Table VII in comparing the IQ's for children who had been reared in similar environments, ratios were computed first for the children of both groups who had been given Kuhlmann-Binet tests when they were 3 and 5 years old. Since the number of cases was very small, Student's *t* test, which is designed to show differences between groups of very small population, was used to compute the significance of differences between mean IQ's. At 3 years *t* was found to be 2.56.

The probability (P) of this value being obtained when there are 21 cases is less than .02; that is, there are slightly fewer than 2 chances out of 100 that the differences found were due to chance. At 5 years t was 2.46, with a probability of between .05 and .02, signifying that there are more than 95 chances out of 100 that a true difference exists between the groups at this age. Since only one Kuhlmann-Binet was

TABLE VII.—COMPARISON OF IQ'S OF CHILDREN PLACED IN
SIMILAR ENVIRONMENTS

Age, Years	Experimental Group		Control Group		t	P
	Num- ber	Mean IQ	Num- ber	Mean IQ		
Kuhlmann-Binet Tests						
3	18	82.1	3	101.0	2.56	.02
5	7	77.85	3	93.7	2.46	.05
6	5	86.7				
Kuhlmann-Binet and Stanford-Binet Tests Combined						
3	18	82.1	7	105.42	6.83	Less than .01
5	7	77.85	5	99.0	3.77	Less than .01
6	5	86.7	3	103.3	2.69	.05

given to a child of the Control Group at 6 years, the t test was not applied. In the second half of the table, the Stanford-Binet tests and Kuhlmann-Binet tests given to the children of the Control Group were combined and compared with the Kuhlmann-Binet tests given the children of the Experimental Group.

Kuhlmann-Binet and Stanford-Binet IQ's were combined in order to increase the number of cases in the Control Group, although the hazards of this procedure were recognized. In view of this fact and of the small number of cases, the results obtained must be considered as merely indicative of a trend, rather than interpreted at their face value.

At these ages (3, 5, and 6) there were no Stanford-Binets given to the children of the Experimental Group. At ages 3 and 5 there is less than one chance in 100 that the differences found between the groups is due to chance; at 6 years there are fewer than 5 chances in 100 that chance could account for the difference found. There were no comparisons made at 4 years because there were too few tests given at this age to permit computation.

The values found at 3 years are probably the most meaningful, since after that age the children with the higher IQ's tend to be eliminated through adoption. The children whose mental development was followed after this age are not representative of the total group.

VII. SUMMARY AND CONCLUSIONS

Forty-eight children whose mothers were feeble-minded and who had been placed in boarding homes or institutions before one year of age were compared with 29 children who had also been separated from their mothers before their first birthdays, but whose mothers were of normal intelligence. Analysis was made of the data available on the putative fathers, the number and socio-economic status of the boarding homes, and the age and intelligence of the children. Although the number of cases was small, statistically reliable differences in intelligence were found between the children of the Control Group and those of the Experimental Group who had been placed in comparable environments. Although these boarding homes were inferior to adoptive homes of the usual type, they were similar for the two groups.

On the basis of tests given between the ages of $2\frac{1}{2}$ to 13 years, marked differences were found between the intellectual level of the children whose mothers were feeble-minded and those of normal parentage. Of the former group, 21 percent tested below 75 IQ; of the latter, none. Fifty-six percent of the cases in the Experimental Group tested below 90 IQ; only 17 percent of the Control Group ranked equally low.

These findings are not in agreement with those reported by Skodak and Skeels. A more extensive study is now in progress, in the course of which it is hoped that some explanation for the discrepancies in the two reports may be found.

CHAPTER XXIV
RETEST CHANGES IN THE IQ IN CERTAIN
SUPERIOR SCHOOLS

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I. RETESTING IN THE UNIVERSITY OF IOWA SCHOOLS

Comparing two groups of children who had attended the University of Iowa preschool, Wellman² found that those who transferred to other schools showed no further gain in IQ, though maintaining the gains registered during preschool attendance, while those who continued to attend the University school showed an additional average gain in IQ of about 7 points. Elsewhere Wellman³ has reported a correlation of .40 between performance on an intelligence test at college entrance and length of attendance at the University schools. The inference follows that something in the superior environment of the University School at Iowa produced a more rapid growth in intelligence, as tested by the Binet, than occurred in other school environments. One is led

¹ The coöperating authors supplied test results from the records of their respective schools and information about the conditions of testing. The analysis of the data and preparation of the report were carried out by Doctor Thorndike.

² B. L. Wellman. "Growth in intelligence under differing school environments." *Jour. Exper. Educ.*, 3: 1934-1935, 59-83.

³ B. L. Wellman. "Mental growth from preschool to college." *Jour. Exper. Educ.*, 6: 1937-1938, 127-138.

to inquire whether this gain is unique to the University of Iowa school, or whether similar phenomena will be observed in other schools that have the advantages of superior children, superior facilities, and presumably superior teachers and curricula. The significance of the Iowa findings will be increased many fold if they are confirmed in data gathered from a completely different source. On the other hand, of course, even if we do not find such gains in the other schools here studied or in any other school in the country, we still cannot *prove* that the results obtained at Iowa are not genuine. However, negative evidence from other sources will tend to throw the burden of proof upon the Iowa experimenters.

II. GENERAL CONDITIONS OF RETESTING IN THE THREE SCHOOLS AT NEW YORK

In order to provide further data for understanding the effect of schooling upon the IQ, we analyzed the Binet retest records that have been accumulated in the files of three of the best-known private schools in and around New York City—Ethical Culture, Horace Mann, and Lincoln. Some of the earlier retest material from one of the schools has already been reported by Hildreth¹ and by Rugg and Colloton.² These records have been accumulated over the past twenty-odd years. They represent retest data on a total of about 3,000 children. Over 1,100 of these retests had been given after an interval of at least 2½ years, and these records will be the ones on which most of our analysis will be based.

All the available records were used, with the following exceptions:

1. No test was considered when the child was over 14 years at the time of testing; this exception was made in order to avoid any possible question as to what chronological age to use in computing IQ's for older children.
2. All later tests were eliminated in which the M.A. predicted from the IQ on the first test would be over 18 years; this exception was made in an effort to eliminate records that might show a spurious decline in IQ because the child had 'gone through the roof' of the test.

The testing was incomplete, in that these 3,000 children represented only a fraction of the total school populations of these schools during

¹ G. Hildreth. "Stanford-Binet retests of 441 school children." *Ped. Sem. and Jour. Genet. Psychol.*, 33: 1926, 365-386.

² H. O. Rugg and C. Colloton. "Constancy of the Stanford-Binet IQ as shown by retests." *Jour. Educ. Psychol.*, 12: 1921, 315-322.

the period covered in the data. A great many children never received more than a single Binet.

We must recognize a possibility that the individuals who received more than one Binet and who make up the population we are dealing with were in some crucial way not representative of the school population as a whole. In an effort to check on this question, statements were requested from the psychologists in charge of testing at each of the three schools. Pertinent excerpts from these statements are these:

School A. Each year at the beginning of the year my office makes up a list of the children who have not had tests for 3 years or more. Then . . . we systematically go through the list, taking children first for whom the time interval since the last test has been longest. However, we are not always able to stick to this schedule . . . Occasionally calls come from teachers or . . . principals to have certain children retested . . . I would say . . . that the total effect in selection, so far as IQ range is concerned, would be random.

School B. During the last 8 years . . . selective factors have to a very slight extent determined which children should have retests. Our regular practice is to retest all pupils in the elementary school at an interval of two or three years . . . This practice of periodic retesting takes care of most of the children who . . . might otherwise have been selected for retests because of some special factor or condition . . . I cannot be sure to what extent special factors did operate in this school in earlier years. I am inclined to believe that the usual reasons for which teachers asked for retests were disparities between the child's work in school and his general aptitude as indicated by the test score on file; or a change in certain other aspects of the child's development or experience which made it desirable to check any consequent change in his mental function that might be revealed by the repeated Stanford-Binet examination. Such changes would include, obviously, improvement in physical condition, recovery from serious illness which might have affected the earlier test results, or any marked change in emotional control or habits of attention and work. The disparity between the evidence of ability as shown by school work and that indicated by the MA and IQ might point to a mental ability either greater or less than that recorded by the questioned IQ.

School C. There are a few whose retests are requested by teachers because of doubt as to the validity of the old ones, or because of

seeming 'slipping.' However, I should roughly estimate this class as comprising not more than 2 percent at the very most. I think fully 98 percent, in other words, are retested simply because it is our aim not to have to trust any one test.

These statements leave one with the impression that any selective effects were probably slight and not of great importance in determining the results. The question of selection will be considered further when the results have been presented and are being discussed.

The quality of the testing represented in these records is probably somewhat variable; part of it was done by advanced graduate students and part of it by experienced examiners. In School C, about nine-tenths of the tests were given by one or the other of two individuals who have served the school as psychologist during the last 20 years. In School A, over two-thirds of the tests were given by one or another of the three examiners. In School B, however, the testing was spread more widely among a number of examiners, and a goodly bit of the testing was done by advanced graduate students and internes. These students were carefully supervised, and their work checked, but of course they did not have the richness of experience of a school psychologist with years of testing experience. It is hard to see why the number of examiners should affect the amount of *constant* change in IQ, although we should expect the variation from test to retest to be somewhat greater with a greater number of examiners, especially if this included some less-experienced examiners.

III. ANALYSIS OF DATA SECURED AT NEW YORK

First let us consider all the children from a given school who had a retest after an interval of $2\frac{1}{2}$ years or more. In the case of any individual who had received more than two tests while in the school in question, the first and the last test were the ones considered. In every case, the differences with which we will work are obtained by subtracting the IQ on the first test from the IQ on the last test. The general results are shown in Table I.

Table I shows us that there has been a tendency to gain in IQ in each school studied. However, in Schools A and C the gain has been so small that it cannot be considered significant either statistically or practically. In School B, on the other hand, there has been a marked

gain, about comparable to that reported in the Iowa studies. The size of the gain is much too large to be attributed to chance, and the dif-

TABLE I.—DISTRIBUTION OF DIFFERENCES BETWEEN INITIAL
AND RETEST IQ

<i>Amount of Change (Difference)</i>	<i>School A</i>	<i>School B</i>	<i>School C</i>	<i>Total</i>
48 to 52	..	2	..	2
43 to 47	..	2	1	3
38 to 42	2	4	1	7
33 to 37	1	9	1	11
28 to 32	3	7	5	15
23 to 27	3	22	20	45
18 to 22	14	31	15	60
13 to 17	26	46	33	105
8 to 12	42	56	56	154
3 to 7	48	62	69	179
— 2 to 2	49	55	72	176
— 7 to — 3	47	48	71	166
—12 to — 8	27	31	65	123
—17 to —13	20	18	42	80
—22 to —18	7	5	9	21
—27 to —23	3	2	3	8
—32 to —28	1	2	1	4
—37 to —33	1	2	3	6
—42 to —38	..	..	1	1
—47 to —43	..	..	1	1
Number	294	404	469	1,167
Mean difference	+ 1.40	+ 6.17	+ 0.65	+ 2.77
S. D.	11.65	13.75	12.36	12.89
S. D. of the mean	0.67	0.68	0.57	0.38

ference between this school and each of the others is also statistically significant. This marked discrepancy obviously calls for further analysis and study.

In order to improve our understanding of the gains in School B, we analyzed all the retest data from this school in terms of the interval between test and retest. If the gains in School B indicate a genuine improvement resulting from the school experience, we should expect them to be cumulative and to become progressively larger, the longer the interval between test and retest. The information on this point is given below in the accompanying tabulation.

<i>Interval in Months</i>	<i>Num- ber</i>	<i>Mean Change</i>	<i>S. D.</i>	<i>S. D. Mean</i>
6 to 17	171	5.0	12.50	0.96
18 to 29	77	5.1	12.05	1.37
30 to 41	111	6.6	13.55	1.29
42 to 53	133	6.4	12.70	1.10
54 to 65	107	6.4	15.50	1.50
66 to 77	29	4.8	12.00	2.27
78 to 89	15	7.1	13.40	3.59
90 to 102	9	-1.4	12.30	4.35

From this tabulation we see that the amount of gain in School B is not significantly related to the length of time between tests. One year of exposure to the school environment results in as much gain upon retest as 6 years does, and there is no reliable difference between the gain at the end of one year and the gain after any longer period. Further evidence on this point comes from the study of 54 records in School B where there were 3 tests. The average gain from the first to the second test, with an average time lapse of about two years, was 7.5 points. The average gain from the second to the third test, with an average time lapse of about 3 years, was 0.3 points. Apparently, then, the gain in School B cannot be attributed to any cumulative effect of the school experience. If the school experience has produced the change, it must be in terms of some initial adjustment that has had its full effect within a year or so.

In an effort to determine why the gains appeared in School B, but not in Schools A and C, the data from each school were fractionated in various ways. Since the testing had been done over a period of more

than 20 years, the results were analyzed in shorter time samples. These results are presented in tabular form.

<i>Time of First Test</i>	<i>School A</i>		<i>School B</i>		<i>School C</i>	
	<i>Aver- age</i>	<i>Num- ber</i>	<i>Aver- age</i>	<i>Num- ber</i>	<i>Aver- age</i>	<i>Num- ber</i>
Before 1920	4.0	2	4.3	59	3.7	100
1920 to 1922	4.1	86	7.6	98	—0.9	73
1923 to 1925	1.0	68	2.8	32	—0.7	81
1926 to 1928	—3.7	47	3.8	53	4.2	113
1929 to 1931	2.6	51	6.1	90	—2.5	76
1932 and later	0.9	43	8.6	42	—3.0	25

All those cases in which the first tests were given within a particular time interval have been grouped together. There we see rather large, irregular changes in the average shift from test to retest. Some of these changes are too large to be attributed readily to chance. However, the irregularities in the ups and downs in any one school suggest that they were caused by changes in the testing personnel or fluctuations in the standard of testing rather than by any progressive real change in the effectiveness of the educational experiences being offered. In no one of the schools is there a clear trend for gains in IQ to become either progressively larger or progressively smaller.

A second analysis of the data was made in terms of age at the time of first test. The records were broken up into three groups—cases where the first test was given (a) before the age of 5, (b) between five and eight, and (c) after the age of eight. The results of this analysis are also given in tabular form.

<i>Years Old at First Test</i>	<i>School A</i>		<i>School B</i>		<i>School C</i>	
	<i>Aver- age</i>	<i>Num- ber</i>	<i>Aver- age</i>	<i>Num- ber</i>	<i>Aver- age</i>	<i>Num- ber</i>
Under 5	2.0	78	4.4	86	5.8	6
5 to 7-11	1.0	172	6.5	259	0.5	359
8 and over	0.8	57	6.2	17	2.0	112

It seems clear from this tabulation that there is no particular relation between the age at which the child was first tested and the

amount that he gained before retest. In School A, where the gains are small in any case, there is a tendency for them to be smaller if the child is first tested after he is 5 years old. In School B, this tendency is just reversed. In School C, very few tests were given below the age of 5, but comparing the 5- to 8-year age range with cases where the first test was given after age 8, we find somewhat larger gains for the older children. The age at which the first test was given is somewhat different for the populations in the three schools. However, the data of the preceding tabulation make it clear that we cannot explain the relatively large gains in School B on this basis. The largest gains in that school were for the large 5-year to 8-year group, which was also the largest group in each of the other schools and the group that showed insignificant gains in these schools.

A third possible explanation of the results in School B is that the examiners who gave the final tests were somewhat more lenient than those who had given the initial tests. Cattell¹ has shown that examiners may differ by as much as 10 or 12 points in the average severity of their grading when pairs of tests on the same children are compared. The examining personnel in the final tests differed somewhat from that in the initial tests in this school.

As a check upon this possibility, a sample of initial-test IQ's was obtained for each examiner (where these could be found), and his average was compared with the average initial-test IQ given by all examiners. Thus, if Examiner A gave higher IQ's on his initial tests than the average of all examiners, a rough correction could be applied to his IQ's.

Using the corrections thus secured and weighting the correction for each examiner by the number of examinations that he gave, an average correction was determined for the initial tests on the one hand and the final tests on the other. This procedure yielded no evidence that the retest examiners were generally more lenient than the initial-test examiners. The correction to be applied to the average of the initial tests was found to be substantially identical with the correction to be applied to the average of the final tests. It is to be admitted that the evidence here is inconclusive because first, the sample of initial tests available for some testers was very small, and second, there is no guarantee that the sample tested by any tester is a random one. As

¹ P. Cattell. "Stanford-Binet IQ variations." *School and Soc.*, 45: 1937, 615-618.

far as it goes, however, the evidence suggests that the gains from initial to final test were due to some factor other than leniency of testing.

In order to see whether the differences between the three schools might be due to differences in the intelligence level of the populations, the means and standard deviations of the IQ's on the first tests have been computed for the individuals upon whom we had retests after 2½ years or more. The mean IQ for Schools A, B, and C are 118.6, 117.5, and 118.8, respectively. The standard deviations of these IQ's are 13.1, 14.2, and 11.9, respectively. It is clear that the three schools are very similar in the superior level of intellect upon which they draw. In this respect they are also comparable to the University of Iowa Demonstration School.

An interesting side light is thrown upon the question of constancy of the IQ at different levels by comparing the variability in the initial tests with that in the final tests. The standard deviations of the distributions of final-test IQ's for the three schools were 14.2, 17.3, and 14.7, respectively. When these are compared with the standard deviations upon the initial tests, as reported in the last paragraph, an increase in variability is observed for each school. In other words, there is a tendency for high and low IQ's to draw apart, as has been indicated by Cattell.¹ Under these circumstances, it seems that some gain on retest should be expected in an above-average group. It may be that the small average gains found for Schools A and C are to be attributed to this effect.

IV. DISCUSSION

We have studied the Binet retest results from three schools that, it seems safe to say, would be generally considered by educators to be superior schools. In no one of these did we find evidence of a cumulative increase in IQ related to the length of time spent in the school environment. In two of the schools (A and C) the gains were too small to be even statistically significant. In the third, appreciable gains were found, but they appeared as well at the end of one year as at the end of 5 or 6 years. Nothing in our data or our knowledge of the schools gives us any clear reason why the results in School B differed from those in the other schools. The difference between the schools cannot be explained in terms of differences in either the intelligence

¹ P. Cattell. "Do the Stanford-Binet IQ's of superior boys and girls tend to decrease or increase with age?" *Jour. Educ. Research*, 26: 1933, 668-673.

level of the populations or the age at which they were tested. Though there are ups and downs in each school, the difference between School B and the others tends to be maintained throughout a 20-year period.

We are at a loss to produce any convincing explanation of the difference. Several alternative hypotheses suggest themselves, however, and the merits of these will now be considered.

1. *School B is a better school, and provides greater intellectual stimulation.* We doubt whether this hypothetical explanation would seriously be upheld by one who knew the three schools. The resemblances between their clienteles, facilities, and approaches to education are much more marked than are any differences between them. But even more damaging to this explanation is the finding that the gains in School B are essentially as large at the end of one year as they are after any longer time lapse.

2. *The testing at School B was more variable.* If this contention were true, it would explain the greater variation from test to retest found in School B, but it is hard to see how it would explain a constant change running through the records. One might possibly argue that inexperienced testers tend to underestimate the intelligence of children who have not yet made an adjustment to the test or to the school environment. On the retest the child would be relatively immune to the inexperienced tester and consequently would show his abilities to better advantage. This explanation seems far-fetched to us, but may need to be considered if no better can be found.

3. *In School B there was a marked general adjustment during the first year or few months, which also carried over to the Binet.* There is no evidence to suggest why this should be the case in School B to any greater extent than in the other schools. A possibility, concerning which we have no satisfactory evidence, is that more children at School B were tested approximately at the time of admission, and thus before adjustment to the school environment had taken place. However, this requires the subsidiary assumption that children do generally test higher after a few months in school than at the time of admission—an assumption that seems open to question. What is more, the gains were also found for the older children at School B, who had become generally adjusted to the school environment.

4. *In School B there was a selective factor determining which children should receive retests.* If there was a tendency to give retests to

children whose school performance deviated from what would be expected from their first tests, and if these were primarily cases whose school work was better than expected, we would expect a gain on the second test. It is clear from our data that there is a large element of chance error in Binet IQ's for young children. Those who test at 100, for example, will cover a considerable range in 'true' ability. If there were a tendency for those who are overrated on the first test gradually to be eliminated from a rather exacting school environment, and a tendency for those who were underrated to be picked out sooner or later for retesting, an apparent gain upon retest would result, which might be independent of the interval between test and retest. We cannot demonstrate that any such influence did operate in School B and not in the other schools, but it may have been none the less.

If subtle and unidentifiable selective factors can operate to produce constant gains of the size and type that we found in School B. it seems at least possible that some analogous influence may have operated to produce the results reported by Wellman.¹ Such an explanation is rather unsatisfying, but does perhaps serve to unite otherwise discordant results.

V. SUMMARY

1. A study was made of the Binet test-retest records for about 3,000 students in three well-known private schools in New York City. The analysis centered on the more than 1,100 cases for which the interval between test and retest was over 2½ years.

2. In two of the schools the average gain in IQ was negligible, while in the third it was appreciable, amounting to over 6 points.

3. The data suggested no satisfactory explanation for the difference reported above, and it remains something of a mystery to the authors, who have to content themselves at present with proffering a plausible, though unsupported, hypothesis to account for it.

¹ B. L. Wellman. "Mental growth from preschool to college." *Jour. Exper. Educ.*, 6: 1937-1938, 127-128.

CHAPTER XXV

DOES ATTENDANCE AT THE WINNETKA NURSERY SCHOOL TEND TO RAISE THE IQ?

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This study has been stimulated by a number of reports that have appeared during the last several years from the Iowa Child Welfare Research Station at the University of Iowa. The general import of those studies led to the conclusion stated by Dr. Beth L. Wellman: "Certainly intelligence cannot be regarded as static; it should be regarded in terms of growth rather than as a fixed quantity."¹ In the same article she says:

A permanent change in intellectual standing can be effected in one to one and one-half years that will last at least four to eight years, up to an average age of twelve years, provided that the children are in schools such as the "other schools" of this study. It may seem surprising that as great and as permanent a change can be accomplished in so short a period, but nevertheless the results confirm this. (p. 80)

While gains in IQ made during attendance at the University of Iowa Nursery School and the Elementary School were retained after transfer to "other schools," additional gains were not made in the "other schools." On the other hand, children tended to continue to gain by attendance at the University Schools and to retain those gains even into college-entrance examinations.² Dr. Wellman says: "In a wider social sense, results such as these may even eventually lead us to the conclusion that, as a race, we are intellectually undernourished."

Of course, those who have held most closely to the theory of the constancy of the IQ have recognized that the development of intelligence

¹ B. L. Wellman. "Growth in intelligence under differing school environments." *Jour. Exper. Educ.*, 3: 1934-1935, 59-83.

² B. L. Wellman. "Mental growth from preschool to college." *Jour. Exper. Educ.*, 6: 1937-1938, 127-138.

follows certain laws of growth. Factors that influence general physical growth, such as malnutrition, illness, and so forth, also affect intellectual growth. In addition, emotional disturbances, particularly those so extreme that they become insanities, have recognizable influence upon the development of intelligence. Exceptional cases of children who have been deprived of normal social contacts through considerable periods of infancy and childhood are reputed to demonstrate lack of intellectual development due to lack of ordinary stimulus and use of intellectual abilities. Dr. Wellman's thesis, however, goes considerably beyond contentions ordinarily made against the theory of the constancy of the IQ.

If it is possible permanently to increase the intellectual level of young children by providing stimulating school environments, that possibility furnishes an exciting opportunity and imposes a tremendous responsibility upon educators who deal with young children.

I. THE PURPOSE OF THIS STUDY

It is not the purpose of this article to examine the many and interesting theoretical implications underlying this question. Rather, we shall examine such pertinent data as we have at hand on graduates of the Winnetka Nursery School to see what, if anything, these data may add to the evidence found elsewhere.

II. THE WINNETKA NURSERY SCHOOL

The Winnetka Nursery School is under the direction of Rose H. Alschuler. Dr. Dorothy Van Alstyne formerly did the psychological work, but, for the last three years, Dr. LaBerta W. Hattwick has been the psychologist. The teaching staff throughout has been composed of highly trained persons. To a considerable extent, the school has functioned in the training of prospective nursery-school teachers. Numerous publications appearing in the field of child development and education indicate the active research and theoretical work done by the staff members. These points are mentioned as justification for the belief that the work done in this school may be properly compared with the work done at the Iowa Child Welfare Research Station or other well-known nursery schools. The following comparisons are drawn with the assurance that we may reasonably expect from the Winnetka Nursery whatever benefits attendance at a good nursery school may offer.

Three modes of comparison suggest themselves. First, we may compare nursery-school children with children of a control group from the same community who are not in the nursery school. Unfortunately, we have no pre-school data on a control group.

Second, we may compare successive tests on the same children during attendance at nursery school and later. The number of children who have attended the Winnetka Nursery School to date has been small. Many had only one test during their attendance. While others have had more than one, several different tests were used. There were not enough check tests on the same children with the same test during nursery-school attendance to give dependable results from comparisons between successive tests. All children were tested a year after leaving the nursery school when they had finished a year in the kindergarten. However, their kindergarten test was still different from the several varieties they had taken during attendance at the nursery school, and there is not a large enough group for any pair of nursery-school and kindergarten tests to provide dependable comparisons when the influence of the difference between tests is considered. Hence, these data were discarded and the second method of comparison abandoned.¹

Third, we may compare nursery-school graduates with larger groups of children in the Winnetka Schools who did not attend the nursery school. According to Dr. Wellman's findings, any positive influence exerted by nursery-school attendance should carry over to later testing periods. The difficulty with this method is that any significant differences found may be ascribed to the probability that the children who attended nursery school were a selected group to begin with. Hence, if significant differences are found, we must await later data to determine the extent to which those differences result from original selection. If, however, no significant differences are found, we are left with two possible interpretations: On the one hand, we may conclude that the nursery-school group is a typical sampling of Winnetka children who have remained typical despite experience in nursery school. On the other hand, we may contend that the nursery-school group was a select or atypical group to begin with, but that the nursery-school experience has offset the influence of those selective factors so that graduates appear as a typical sampling. In the absence of definite evidence to the contrary, the law of parsimony forbids the second interpretation.

In short, the data at hand are not of the nature of data planned and secured to answer our question. They are gleaned from working records built up over several years' time in a system where testing pro-

¹ It should be said that for the last two years the Revised Stanford-Binet, Forms L and M, have been used in the nursery school and in the course of a few years they will provide us with significant data under this method.

grams have been changed experimentally from time to time. We can only use whatever information they provide with the assurance that better data will be available in the future.

Of the 114 graduates of the Winnetka Nursery School included in this study, approximately 25 percent attended less than one full year; 22 percent attended just one year; 11 percent attended one and a fraction years; 22 percent attended two years; 13 percent attended two and a fraction years; and 7 percent attended three full years.

The distribution of these graduates according to year of birth is shown in the following tabulation.

Birth Year	'23	'24	'25	'26	'27	'28	'29	'30	'31	All
Number	1	12	9	16	9	18	17	12	20	114

The following figures show the distribution of the same children according to the year they entered first-grade groups in the Winnetka schools. The numbers from year to year do not correspond because

Year Entered										
Grade I	'29	'30	'31	'32	'33	'34	'35	'36	'37	All
Number	2	12	9	15	12	14	15	13	18	110

14 of the children entered 'underaged;' that is, through a special examination, they were permitted to enter a year earlier than they would have done ordinarily. The total is reduced to 110 because 4 children left Winnetka after their nursery-school experience and returned later to enter some grade above the first.

III. RESULTS OF COMPARISONS WITH RESPECT TO INTELLIGENCE QUOTIENTS

Table I shows eight comparisons. In each comparison, except miscellaneous Stanford-Binet's (see discussion later), the nursery-school group is included in the larger group. This results in one advantage: each school group includes all Winnetka school children who had the tests reported during the same period of years that the nursery-graduates received them. Hence, they represent as near a normal sampling as possible. However, including the nursery group in the larger group

has also one disadvantage—a minor one under the circumstances: if the nursery groups were taken out of the larger ones, the differences between them would be slightly increased.¹

The table shows the number of cases in each group, the mean IQ and its probable error, the differences between the means of the school and the nursery groups for each test with the probable errors of these differences. In no case is the observed difference significant.

The standard deviations, their P.E.'s and Q's² are shown for each comparison. On the whole, the spreads of the distributions involved in each comparison are reasonably similar. The difference between the standard deviations for 'grand total Binet' is about twice the probable error of the standard deviation for the nursery group. The only figure showing a larger relative difference is 'miscellaneous Stanford-Binets' where the difference between the standard deviations is about three and a third times the probable error of the standard deviation of the nursery group. Even that difference is within the probability of chance. The groups of 'miscellaneous Binets' are the least comparable of the lot, as we shall see later.

Skewness may be measured by determining how far the mode of a distribution (which approaches the normal curve in shape) falls above or below the arithmetical mean with the distance expressed in terms of the standard deviation. Since a true mode is difficult to determine in a wide scatter of few cases, I have used the assumption that the mode falls approximately three times as far from the mean as does the median. Since the medians are expressed to the whole IQ point, the means have also been taken only to whole IQ points; for example, any mean falling between 113.00 and 113.99 was considered as falling in the 113th IQ point. Hence, those distributions in which the mean and the median both fall within the same IQ point show zero skewness. That occurs in 8 of the 16 distributions. In 6 other distributions the mean falls in the IQ point adjacent to the one in which the median

¹ A simple proportion will give a rough estimate of the extent of that increase. Take 'N' as the number of children in the school group and 'n' as the number in the nursery group. Take 'D' as the difference shown between the two medians, or means, and 'd' as the increase resulting from taking the nursery cases out of the larger distributions. Then $n:N-n::d:D$. In all cases 'd' would be but a small fraction of one IQ point.

² Q is taken as half the difference between the 75th and the 25th percentile; that is, between Q_3 and Q_1 .

falls, showing a skew (distance between mean and mode) of about one-fourth of a standard deviation or less. The 10 nursery cases included as 'underaged Stanford-Binets' are not significant. That leaves but one distribution, the nursery-school group in the classification 'miscellaneous Stanford-Binets,' that has a considerable positive skew. (It should be noted that 6 of the 8 skews are negative.)

This outcome is important for it shows the character of the Winnetka distribution. As a suburban community, it does not show a normal spread skewed strongly toward the upper ranges. Instead, it shows a rather surprisingly symmetrical distribution in which the whole curve is pushed up from 13 to 16 points. The nursery-school groups fit as closely to the type and range of the larger group in each case as one could expect on the basis of a random sampling.

The figures in each row of Table I must be considered as a separate study, not only because each comparison represents a different set of tests but also because each comparison (with the exception of the Detroit First-Grade and Pintner-Cunningham Primary Mental Test) involves a different group of children. Therefore, we shall have to give a brief description of the source of the data for each comparison.

For a number of years the Detroit First-Grade Group Intelligence Test and the Pintner-Cunningham Primary Mental Test were given each June to the kindergarten groups (the first two comparisons). These tests were discontinued in the spring of 1934 when only a part of the children were tested. Since that time we have used the Kuhlmann-Binet, given by the kindergarten teachers who have been specially trained for this testing. The nursery-school children represented in these figures were the earlier graduates.

For several years the Kuhlmann-Anderson Group Test of Intelligence was used as a survey check at the third-grade level in October of each year. That practice was discontinued in 1937 in favor of the use of the Stanford-Binet as a check on the earlier Kuhlmann-Binet. Only the earlier nursery-school graduates reached the third grade in time to receive this test.

During the school year of 1931-1932, the psychologist trained the kindergarten teachers in the giving of the Kuhlmann-Binet examination. In June of 1932 and each June since then, the kindergartens have closed two weeks before the rest of the schools and the teachers have tested the children. These tests were considered as entrance tests for first grade and are referred to as 'first-grade' tests. Nursery-school alumni received them one year after graduation from the nursery school. These tests are included in the fourth comparison shown in Table I.

As with any testing program, a certain number of the kindergarten children were ill during the spring testing, or their parents took them out of town before school closed. A few children did not attend a kindergarten. All such cases were tested in September when they entered first grade. The tests were given by the psychologist or his assistant, who was formerly one of the kindergarten teachers. The assistant's tests are included in the comparison listed in Table I as 'total first-grade Binets.' The 91 tests added to the 'school' group and the 18 tests added to the 'nursery' group were given by the psychologist. In addition to these children, there are included a few special cases referred to the psychologist for testing because of the kindergarten teacher's concern over some aspect of their development. Of the 91 cases, 53 were Kuhlmann-Binet tests and 38 were Stanford-Binet. Of the 18 cases added to the 'nursery' group, 10 were Kuhlmann-Binet and 8 Stanford-Binet.

The turn-over in the Winnetka schools is considerable. Under 'miscellaneous Binets' are included the 242 'school' cases that represent children in the elementary schools during the year 1938-1939 who had entered in some grade above first. The 'nursery' group represents: three of the four children who also entered later than first grade, having left Winnetka for a time after attending nursery school; 13 of the children who entered first grade before 1932 and hence did not receive the Kuhlmann-Binet. Since 16 is too small a number of Stanford-Binets to compare satisfactorily, 38 additional Stanford-Binet checks on children who had also had the Kuhlmann-Binet for first grade were included to make up the 54 cases. While this selection of 'nursery' cases is not exactly parallel to the 'miscellaneous Binets' of the 'school' group, it does provide a comparison for Stanford-Binets. Of course, the 38 check tests were not included in the 'school' group here. Neither were the other 16 cases because they were in the junior high school when the cases for the 'school' group were taken from the elementary grades. This is the only case where the 'nursery' group is not included in the 'school' group (except in the 'grand total,' where again the 16 older children and a few others are included in the 111 nursery-school cases, but not in the 'school' group).

Children are admitted to kindergarten in the Winnetka schools if they are 5 years old before the first of January following the September when they enter. Children whose birthdays fall after the first of January may be admitted 'underaged' by special test at the request of the parents (listed as 'underaged Stanford-Binets' in Table I). Some of the children who are given 'underaged' tests are not retested upon entrance to first grade. (Those few with underaged tests who were retested for first-grade entrance are included in the 'total Kuhlmann-Binet tests given by kindergarten teachers' and the 'total first-grade Binets' above.) The small number of such children in the 'nursery' group makes the comparison of 'underaged Stanford-Binets' of no particular value in itself. However, these cases must be added to the tests

given under other circumstances if we are to have a complete representation of the Winnetka school population for the comparison designated as 'grand total.'

The 'grand total' is simply a summary of the total of all Binet tests shown in the four classifications preceding the 'grand total,' except that the 38 check tests in the 'nursery' group under 'miscellaneous Stanford-Binets' are omitted. These tests represent 896 different children for the 'school' group. Most of the 'nursery' group is included in the 'school' group, though some 20 cases of earlier graduates are not.

In summarizing our comparison of distributions of IQ's in nursery-school graduates with the distributions in larger groups of Winnetka school children, we find the nursery-school groups slightly higher in all cases except that of the 'Kuhlmann-Anderson third-grade group.' However, the differences are too slight to be significant. Both in scatter and in central tendency, the nursery-school groups prove to be as typical a sampling of the general school population as one could expect from a random sampling with such small numbers of cases. *We must conclude that, so far as this evidence goes, experience in the Winnetka Nursery School does not tend to raise the IQ's of the children.*

IV. RESULTS OF COMPARISONS IN READING ACHIEVEMENT

To check up on the possible effect of nursery-school attendance upon later academic achievement, comparisons have been made of achievement in reading as indicated by several reading tests given at various levels. Table II sets forth the results.

The Metropolitan and Garvey reading tests were given by first-grade teachers to their classes at the close of the first-grade year. The 'nursery' group averages younger chronologically, presumably by chance and owing to the relatively small number of cases in these groups. A similar difference appears in the Stanford Test group.

The Haggerty tests were given by the psychologist as a spring survey test at the close of the second grade.

The Pressey tests were given by the psychologist at the close of the third grade. A few fourth-grade classes are also included.

The Gates tests were given by fifth-grade teachers, some in the fall and some in the spring.

The New Stanford tests were given by the sixth-grade teachers.

A summary reveals that in no case is the difference between the achievement of a group of nursery-school graduates and that of a

TABLE II.—COMPARISONS BETWEEN READING SCORES OF NURSERY-SCHOOL ALUMNI AND THOSE OF LARGER GROUPS OF WINNETKA CHILDREN ACCORDING TO SEVERAL TESTS GIVEN AT DIVERSE TIMES DURING THE SIX ELEMENTARY GRADES, SHOWING ALSO MEAN CHRONOLOGICAL AGES AND MEAN MENTAL AGES FOR EACH GROUP AT THE TIME THE READING TESTS WERE GIVEN

Group	Number of Tests	Grade in Reading		Chronological Age			Mental Age			Mean M.A.				
		Mean	P.E. of Mean	S.D.	Years Months	Mean	P.E. of Mean	S.D.	Years Months		Mean	P.E. of Mean	S.D.	Years Months
Metropolitan Primary Reading A														
School	177	2.04	.03	.64	7	0.5	.38	7.4	8	2.2	.50	9.8	116	
Nursery	24	1.88	.07	.55	6	9.8	.80	5.6	8	1.4	1.28	9.0	119	
Difference		.16	.08			2.7	.88			.8	1.14			
Garvey Primary (Form I)														
School	299	2.34	.03	.72	7	0.6	.26	6.6	8	1.3	.36	9.2	115	
Nursery	38	2.22	.08	.70	6	10.6	.40	3.6	8	1.2	.95	8.7	118	
Difference		.12	.08			2.0	.47			.1	.10			
Haggerty Sigma I														
School	472	3.25	.03	1.03	7	10.7	.22	7.2	8	11.0	.37	11.9	113	
Nursery	45	3.41	.11	1.12	7	11.4	.66	6.6	9	1.6	1.05	10.4	115	
Difference		.16	.12			.7	.70			2.6	1.11			

Pressey Diagnostic (Total Score)													
School	444	5.50	.05	1.58	9	5.4	.33	10.4	10	10	.54	16.7	115
Nursery	56	5.38	.15	1.69	9	5.5	.92	10.2	10	9.2	1.43	15.9	114
Difference		.12	.16			.1	.98			.8	1.53		
Gates Intermediate (Total Score for A, B, C, D)													
School	646	7.03	.05	1.95	10	7.1	.22	8.2	12	3.3	.44	16.5	116
Nursery	59	7.04	.19	2.16	10	7.6	.65	7.4	12	2.0	1.35	15.4	114
Difference		.01	.20			.5	.69			1.3	1.42		
New Stanford													
School	337	7.30	.06	1.52	10	10.9	.27	7.4	12	7.5	.61	16.6	116
Nursery	30	7.36	.20	1.61	11	0.9	.83	6.8	12	7.1	1.82	14.8	114
Difference		.06	.21			2.0	.88			.4	1.52		

larger school group large enough to be significant. *We must conclude that experience in the Winnetka Nursery School has no influence upon the later reading achievement of its graduates that is large enough to be detected by such comparisons.*

One other bit of evidence must be mentioned here that corroborates the general conclusion just given.

For purposes of tabulation, remedial readers in the Winnetka schools are defined as those children who fall a year or more below the average of their chronological and mental ages on standard reading tests.¹

Remedial readers, as such, do not usually appear before fourth-grade level. Before that time they are slow or retarded readers, deserving of individual attention, but may not properly be lead into relatively intensive corrective work. Of all children now in the fourth, fifth, and sixth grades in the Winnetka elementary schools, 5.4 percent have fallen at one time or another into the remedial classification. Of the 81 nursery-school graduates who have reached these grades, 8.6 percent have been remedial. This accords with the difference found in percentage of psychiatric referrals, next to be discussed.

V. RESULT OF COMPARISONS IN EMOTIONALITY

A third type of comparison was made as a matter of interest. For a number of years we have had psychiatric services in the Winnetka schools and, for the past four years, we have had a full-time psychiatrist on the school staff. With a total school population of nearly 1,600 children, it is, of course, impossible for the psychiatrist to see all the children. From the very nature of his work, he tends to concentrate on a fairly small percentage of children whom he follows through with extensive series of interviews, repeatedly conferring with parents, teachers, and others concerned. However, he does deal with a good many cases where his contact does not extend beyond an interview or two. Material of this nature is not easily subject to statistical analysis. For our present purpose, I have simply counted the

¹ One group is excluded from this general classification. Children with very high IQ's whose mental ages fall more than two years above their chronological ages, may be a year or more below the average of their mental and chronological ages and still be reading as well as, or better than, the average child of their chronological age. Such children are not called remedial readers primarily because the methods of treatment are of a different character from those used on remedials.

number of referrals with interview records without any attempt at further analysis. I find that 39.5 percent of the nursery-school group have been referred to the psychiatrist's attention at one time or another. Of the balance of the school population, exclusive of nursery-school graduates, 18.6 percent have been referred.

This is a significant difference. It leads to one or both of two probable interpretations, which need further study.

First, the nursery-group may be selected in part from problem situations. Since it has been the habit of those in charge of the nursery school to offer corrective or therapeutic services as well as more general training services, it is but natural that they should attract problem children out of proportion to their frequency in the general population. The extent to which the nursery-school services tended to minimize the severity of the problems thus attracted is not indicated. That they did not fully eliminate them is apparent.

Second, whether or not the nursery group tends to be selected so as to show a larger percentage of problems than the general population, we still have the question as to whether something in the set-up tends to result in more frequent later referrals for psychiatric attention. Personnel records in nursery school are far more elaborate, and contacts and discussions with parents are more frequent and detailed, than in any other portion of the Winnetka school system. Does this intensive work with the home set up tendencies in parents that lead them to follow their children through later years so aggressively that teachers, or parents themselves, tend to appeal more frequently for psychiatric help? Or does the follow up of nursery-school graduates by the nursery-school staff with later teachers lead in that direction?

It would be interesting to follow these questions further. A follow-up study that Drs. Van Alstyne and Hattwick conducted by means of rating scales reaches some interesting and pertinent conclusions.

When the follow-up group is compared with the general Winnetka School population on the basis of two yearly ratings on the Winnetka Scale for Rating Behavior and Attitudes, it is found that the group had from 3 to 18 percent better scores than the norm and that there is a tendency for the children who had attended nursery school to evidence better emotional adjustment and leadership. The former nursery-school group is better than the general school population in "reaction to failure," "independence of adult approval," "direction of group tasks," and "independence of adult help." The lowest score

(but still above the norm) was in "organization of materials for work." It is possible that the influence of nursery school makes the group as a whole as much better than the norm as indicated, but since this group was a somewhat selected and superior group in the first place, it is not probable. It is likely, however, that in the particular situations in which children who had attended the nursery school showed most superiority, the influence of the nursery school can be seen, particularly when comparison with the goals of the nursery school is made. (p. 68)¹

VI. CONCLUSIONS

In conclusion, graduates of the Winnetka Nursery School prove to be a very typical sampling of Winnetka children as a whole so far as the average and spread of their IQ's and reading achievements are concerned. Comparisons give no evidence that the nursery experience has any determining effect upon intellectual level or upon later general reading achievement.

There is evidence that nursery-school graduates tend to show a higher percentage of emotional problems and remedial academic difficulties (as in reading). To what extent this tendency is due to selection of pupils or to what extent the nursery experience minimizes or accentuates such a tendency is not determined.

¹D. Van Alstyne and L. A. Hattwick. "A follow-up study of nursery-school children." *Child Develop.*, 10: 1939, 43-72.

CHAPTER XXVI

IOWA STUDIES ON THE EFFECTS OF SCHOOLING

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I. PURPOSE OF THIS CHAPTER

In a series of investigations at the Iowa Child Welfare Research Station during the past six years, changes in intelligence of preschool and elementary-school children have been reported. The central theme of these investigations has been the association of such changes with conditions of schooling, both at the preschool and at the elementary-school ages. One study carried preschool children through consecutive periods of growth into the high school and college, the point of reference again being the effect of different conditions of schooling upon later mental development.

The purpose of this chapter is to summarize these investigations. Only the broader aspects of the results will be duplicated here; for details, the reader is referred to the original sources (5, 17, 19, 20, 21, 22). The material will be presented in three sections dealing with mental growth (a) during preschool years, (b) during elementary-school years, and (c) from preschool to high-school and college.

Companion studies on the influence of home environment, with particular reference to foster children, have been made by Skeels and his associates. These are summarized by Skeels in Part II, Chapter XX.

1. Origin of the Studies

With the opening of the doors of the Iowa Child Welfare Research Station in September, 1917, studies were begun by the first director of the Station, Professor Bird T. Baldwin, on the relation between physical and mental development of school children through the method of systematic, consecutive measurements. The first Stanford-Binets in the program of repeated measurements were taken in September,

1917, and a report of the results during a four-year period was published by Baldwin and Stecher (1). In their general conclusions they said (p. 58) that the Stanford Revision of the Binet scale "in its present form" has proved unsuitable "as a means for measuring mental growth."

Nevertheless, for various reasons, the program of repeated measurements was continued. When the writer began analysis of the data for an article (19) published in 1932, she, too, felt pessimism about the adequacy of the test, because casual inspection of the records revealed wide fluctuations in the IQ's on repeated tests. Closer analysis, however, revealed that the fluctuations fell into meaningful patterns. There were indications, too, that the changes might in some way be associated with the experiences of the children. On this point, data on the preschool children afforded a definite check, since a number of children had received tests near the beginning of the preschool year and retests near the end of the preschool year, thus permitting comparisons of IQ change during periods of attendance and non-attendance.

In the early program of the preschool, two tests per year had been taken as checks on the validity of an IQ at these ages. Baldwin and Stecher, in *The Psychology of the Preschool Child* (2), reported increases in IQ with retests, but did not compare periods of attendance with periods of non-attendance. In the discussion of results they said:

The later I.Q.'s are in general higher than the first ones, reflecting habituation to experimental conditions, practice, increased facility in the use of language, and mental stimulation resulting from the laboratory activities. In some cases the increase in mental age is so great as to give the impression that the child has actually increased in intelligence. A fairer interpretation would be that the first examination did not actually represent the child's intelligence or that the favorable environment had developed the potential mental ability of the young child. This actual demonstrable increase in mental status is an argument for giving the young child such opportunity for mental growth. (p. 62)

The first comparisons by the writer of fall-spring changes with spring-fall changes were sufficiently promising to warrant a more elaborate analysis, which was next undertaken. Subsequently, the preschool children were followed through the elementary-school years. Analysis of these records revealed differences in patterns of growth associated with the different school systems.

Although a fairly large number of studies have been completed, they constitute only a beginning. They are fragmentary in comparison with the total problem. Effort so far has been directed mainly towards comparing differences in mental growth with differences in educational conditions, leaving to the future the more difficult task of detailed study and analysis of the dynamics of the environments. Here and there, indications on the dynamics appear in the studies, but the problem deserves more systematic treatment than it has yet received.

2. Orientation with Studies by Other Investigators

While the Iowa studies represent rather distinct segments of the whole problem of environmental influences, they fit in as units in the rather extensive literature on this general topic. It is not the intention here to present a complete orientation of these studies with the literature. However, it may be well to mention briefly a few of the more closely related investigations.

There are only a few published studies on the effects of preschool attendance upon intelligence. With the exception of Waring's study, which was reported very briefly, they have been based on small numbers of cases. Goodenough (6) published a preliminary report based upon Kuhlmann-Binets of 28 children who had been in nursery school for one year, compared with an equal number who had not been in nursery school. Both groups showed increases in IQ. The increase for the nursery-school children was slightly greater than that made by the control group, but the difference was not reliable. Kavin and Hoefler (8), using the Merrill-Palmer scale, studied two matched groups of 22 children each. Both the preschool and the control groups gained, but there was no difference in gains between the two groups.

Barrett and Koch (3) studied two matched groups of 17 children each in an orphanage, using the Merrill-Palmer scale. The gain in IQ of the control group was 5.1 points; that of the nursery-school group, 20.9 points.

Waring (18) reported as much gain in mental age on the Merrill-Palmer scale by 103 preschool children in 5 months of preschool attendance as was made by 21 of the children in 8 months of vacation time. She also reported a gain of 10 months in mental age on the Stanford-Binet by 83 children in 5 months of preschool attendance, and a gain of 12 months in mental age by 52 children in a 9-month period that included vacation.

Newman, Freeman, and Holzinger (14), in a recent study, reported a correlation of .79 between magnitude of differences in educational opportunities and magnitude of differences in Binet IQ for identical twins separated and reared apart. Klineberg's (9) findings on rise in IQ of Negro children with number of years' residence in New York City are in accord with the general theme of increased intelligence associated with improved educational conditions, although the changes in his study were not related specifically to schooling.

Studies of children in isolated communities showing large decreases in IQ with age fit into the general pattern also. The work of Gordon (7) on canal-boat children and of Sherman and Key (15) on children in extremely isolated mountain communities may be mentioned. More recent reports on children of mountaineers support their findings of decreases in IQ with age. A good critical summary of the problem of socio-economic status in relation to intelligence was published recently by Neff (12), who discusses in some detail the studies just mentioned and others related thereto.

II. MENTAL GROWTH DURING THE PRESCHOOL YEARS

1. In the Iowa Preschool Laboratories

From September, 1921, when the preschool laboratories were established, to June, 1938, 1,285 children were enrolled in the preschools. This number includes children enrolled in the Junior Primary (kindergarten) section. The age range is, therefore, 2 to 6 years. Of this number, 350 children attended for summer sessions only, and 127 additional children were enrolled during the regular academic year, but did not attend a complete year. The remaining 808 children were enrolled for at least one regular year; many for two or more years.

As a general policy, each child received a Binet test in the fall and a retest in the spring each year that he was enrolled. This policy has been closely adhered to since 1927, but was somewhat less consistently applied prior to that date. The fall-spring tests form the basic data for the following section on mental growth during the preschool years. A 'fall test,' to be included in the analysis, must have been taken between August 1 and December 31; a 'spring test,' to be included, must have been taken between March 1 and June 30. Most fall tests were given in October and November; most spring tests, in April and May, thus making comparable the mean fall-spring and spring-fall intervals.

Of the 808 individuals, 652 were included in the analysis of fall-spring changes. Reasons for exclusion of the remaining 156 children were that they did not receive two tests within the required limits, owing mostly to irregularities of attendance on account of illness, and failure of examiners, especially during the early period, to give the tests within the prescribed limits or to secure adequate rapport on one of the tests. The number of children who, because of inadequate rapport, could not be included for at least one year's records, was 12.

The 652 individuals for whom complete records were available for at least one year of attendance were distributed thus in chronological age at time of the fall test:

<i>Chron. Age in Months</i>	<i>Children</i>
18 to 29	61
30 to 41	175
42 to 53	172
54 to 65	188
66 to 77	56
Total	652

As a general rule the Stanford-Binet, 1916 Revision, was used with children aged 42 months and above and the Kuhlmann-Binet with children below that age.

This policy has been applied consistently since 1927. Prior to that, the Stanford-Binet was used at all ages, except for some cases in 1926 who received the Kuhlmann test. In an article (20) published in 1932, the mean IQ was computed for 3-year-old children tested on the Stanford Revision, compared with the mean IQ for 3-year-old children tested on the Kuhlmann Revision. The means and standard deviations were comparable.

<i>Test</i>	<i>N</i>	<i>Mean IQ</i>	<i>S.D.</i>
Kuhlmann	75	110.8	17.4
Stanford	97	111.4	15.2

Since the means at this overlapping age were comparable and since changes in IQ from fall to spring were comparable at the different ages, it was decided to treat the results as if based on one continuous revision of the scale.

Several examiners participated in the testing program each school year. The examiners were staff members or research assistants in child psychology. No attempt was made to have a child retested by the same examiner. The testing was done without attempt to acquaint the examiner with the results of the previous testing. In general, the assignments of examiners were made by taking into consideration availability of time and amount of previous experience with young children. The more experienced examiners were assigned to the younger pre-school children.

That the children constituted a superior group, coming from homes of high socio-economic and educational levels, is clearly indicated in the Coffey and Wellman study (5) of cultural status in relation to IQ changes of children attending the preschool laboratories. This study utilized the 417 children available in the preschools of the Iowa Child

<i>Points of IQ Change</i>	<i>N</i>	<i>Points of IQ Change</i>	<i>N</i>
+ 43 to + 47	1	— 2 to + 2	113
+ 38 to + 42	1	— 3 to — 7	69
+ 33 to + 37	9	— 8 to — 12	31
+ 28 to + 32	19	— 13 to — 17	12
+ 23 to + 27	24	— 18 to — 22	6
+ 18 to + 22	55	— 23 to — 27	7
+ 13 to + 17	72	— 28 to — 32	0
+ 8 to + 12	108	— 33 to — 37	1
+ 3 to + 7	124	Total	652

Welfare Research Station from 1921 to 1933. (This should be representative of the larger sampling that runs to 1938.) It was found that 67 percent of the fathers were in the professional occupation, that 73 percent of the fathers had 16 to 20 years of formal schooling, and that 53 percent of the mothers had 16 to 20 years of formal schooling. No father was below Occupational Group IV. Only 3 percent of the fathers and 2 percent of the mothers had as little as 8 to 11 years of schooling.

Changes in IQ were made during preschool attendance. The 652 individuals who attended preschool for one year made a gain of 6.6 points between the fall and spring tests. Their mean initial IQ was 116.9. Changes were widely distributed, as is shown above.

The changes ranged from a gain of more than 40 points to a loss of more than 30 points. Fifty-three percent of the children changed 8 or more IQ points between the fall and spring examinations.

The gains were cumulative over the first two years of preschool attendance. There were 228 children for whom complete test records were available over two years of preschool attendance and 67 children for whom records were available over 3 years of attendance. Large gains were made over the first year and an additional smaller gain was made over the second year, but there was very little change over the third year. The gain for the 228 children over the first year was 7.0 points. There was a loss of 0.4 point from spring to fall and a gain of 3.8 points over the second year. The net change from the first fall to the second spring was 10.4 points.

Two Years' Attendance (N = 228)

<i>Item</i>	<i>Year</i>	<i>Fall</i>	<i>Spring</i>	<i>Change</i>
IQ, points	First	117.3	124.3	+7.0
C.A., months	First	40.0	46.0	6.0
IQ, points	Second	123.9	127.7	+3.8
C.A., months	Second	53.8	59.7	5.9

The sixty-seven children having three years' attendance gained 7.7 points the first year, lost 0.6 point over the summer, gained 4.3 points the second year, lost 2.6 points over the second summer, and

Three Years' Attendance (N = 67)

<i>Item</i>	<i>Year</i>	<i>Fall</i>	<i>Spring</i>	<i>Change</i>
IQ, points	First	116.6	124.3	+7.7
C.A., months	First	31.7	37.7	6.0
IQ, points	Second	123.7	128.0	+4.3
C.A., months	Second	45.2	51.0	5.8
IQ, points	Third	125.4	127.1	+1.7
C.A., months	Third	58.1	63.9	5.8

gained 1.7 points over the third year. The net change from the first fall to the third spring was 10.5 points.

From the two-year and three-year attendance groups, the children who tested average were selected. They, too, showed a cumulative gain over the first two years, but no appreciable change over the third year. The gain over the first year for the 72 average children attending 2 years was 9.5 points. Over the summer, they gained 3.9 points. Over the second year, their gain was 4.0 points. Their total net gain from the first fall to the second spring was 17.4 points.

The 26 average children who attended 3 years made gains comparable to the larger group. Over the first year, their gain was 8.9 points. Over the first summer, their gain was 4.6 points; over the second year, again 4.6 points. Over the second summer, they lost 0.1 point; over the third year, they gained 0.9 point. Their total net gain from the first fall to the third spring was 18.9 points.

Children of 90 to 109 IQ				
Two Years' Attendance (N = 72)				
<i>Item</i>	<i>Year</i>	<i>Fall</i>	<i>Spring</i>	<i>Change</i>
IQ, points	First	101.1	110.6	+9.5
C.A., months	First	40.7	46.9	6.2
IQ, points	Second	114.5	118.5	+4.0
C.A., months	Second	54.7	60.8	6.1
Three Years' Attendance (N = 26)				
IQ, points	First	101.5	110.4	+8.9
C.A., months	First	32.7	38.8	6.1
IQ, points	Second	115.0	119.6	+4.6
C.A., months	Second	46.2	52.0	5.8
IQ, points	Third	119.5	120.4	+0.9
C.A., months	Third	59.2	65.2	6.0

The superior children (110-119 IQ) showed similar results of large gain over the first year, less gain over the second year, and no appreciable increase in the mean from the second spring to the third spring. For the 60 children with two years of attendance who tested 110 to 119, the gain over the first year was 8.9 points; the loss over the summer

was 3.3 points; the gain over the second year was 3.9 points. Their total net gain from the first fall to the second spring was 9.5 points.

The 18 superior children who attended three years showed comparable gains. Over the first year, their gain was 9.9 points; over the first summer, their loss was 3.3 points; over the second year, their gain was 4.3 points; over the second summer their loss was 2.5 points; over the third year, their gain was 3.1 points. Their total net gain from the first fall to the third spring was 11.5 points. These figures are reduced to tabular form herewith.

Children of 110 to 119 IQ				
Two Years' Attendance (N = 60)				
<i>Item</i>	<i>Year</i>	<i>Fall</i>	<i>Spring</i>	<i>Change</i>
IQ, points	First	114.8	123.7	+8.9
C.A., months	First	38.5	44.3	5.8
IQ, points	Second	120.4	124.3	+3.9
C.A., months	Second	52.0	57.8	5.8
Three Years' Attendance (N = 18)				
IQ, points	First	114.8	124.7	+9.9
C.A., months	First	30.7	36.6	5.9
IQ, points	Second	121.4	125.7	+4.3
C.A., months	Second	44.4	50.2	5.8
IQ, points	Third	123.2	126.3	+3.1
C.A., months	Third	56.1	62.2	6.1

A comparison was made of preschool and non-preschool children. In order to make non-preschool children strictly comparable to the

	<i>C.A., Months</i>		<i>IQ, Fall Test</i>		<i>IQ, Spring Test</i>	
	<i>Fall Test</i>	<i>Spring Test</i>	<i>Mean S.D.</i>		<i>Mean S.D.</i>	
Preschool	40.4	46.7	120.1	16.2	127.1	11.0
Non-preschool	40.6	45.7	120.0	17.8	116.1	15.7
Difference	.2	1.0	0.1		11.0	
Ratio					3.34	

fall-spring preschool children on season of the year between tests, non-preschool cases who had tests in the fall and retests in the spring were selected. (See Wellman, Ref. 21.) Thirty-four pairs of non-preschool and preschool children were matched with respect to age and IQ. The non-preschool children showed a mean loss of 3.9 points in IQ; the preschool children, a gain of 7.0 points. The difference of 11.0 points on the spring test was statistically significant (ratio of the difference to the standard deviation of the difference, 3.34).

Correlations between number of days of preschool attendance (between a fall and a spring test) and magnitude of change in IQ were computed for three groups of average, superior, and very superior children. The correlations all approached zero, showing no tendency for change during one preschool year to be related to number of days' attendance. The range of attendance was from 37 days to 148 days. The correlations are shown in tabular form.

<i>IQ Level</i>	<i>N</i>	<i>Days' Mean Attendance</i>	<i>S.D.</i>	<i>r</i>	<i>P.E.</i>
120 to 139	121	87.8	20.9	— .03	.06
110 to 119	101	88.0	21.3	.10	.07
90 to 109	110	91.0	24.1	.08	.06

Likewise, correlations between number of days in the interval between fall and spring tests and change in IQ approached zero. The same groups were used as in the correlations for days' attendance. The intervals ranged from 132 to 253 days. The correlations were .08, .02, and .04 for IQ levels 120-139, 110-119, and 90-109, respectively.

Cultural status of the parents was related to the child's IQ on entering preschool, but was not a significant factor in the changes in intelligence while attending preschool. The mean IQ on the fall test was higher for children whose fathers were in Occupational Group I (professional) than for those whose parents were in Occupational Groups II to IV (semiprofessional, managerial, clerical, skilled trades, retail business, semiskilled occupations, minor clerical positions, minor business, and farmers). However, the gains from fall to spring were very similar for the two groupings (6.0 and 5.7). The means are published by Coffey and Wellman (5).

Over the summer months neither grouping changed significantly. Group I showed a mean change of $-.62$ point and Groups II to IV a change of $.30$ point.

The mean IQ of children entering preschool was related to mid-parent education, but the changes during preschool attendance were not significantly different for the groups classified according to mid-parent education. The means were as follows:

<i>Mid-parent Education, Years</i>	<i>Children</i>	<i>Mean IQ in Fall</i>	<i>Mean Gain in IQ</i>
8 to 11	20	105.4	6.9
12 to 15	181	115.8	6.8
16 to 20	263	121.2	5.8

Will very superior children, when placed in an environment designed to be more stimulating than the usual preschool environment, tend to gain in intelligence quotient?

An investigation planned to help answer this question was undertaken by McCandless (11). From the 4-year-old group of the preschool laboratories two groups of 6 children were matched with respect to age (means 52.2 and 51.2 months) and IQ (means 139.3 and 138.5). All the children tested 124 and above on the Stanford-Binet in the fall. The range for the experimental group was 125 to 165, for the control group 124 to 160. The control group experienced the regular preschool program. The experimental group received preschool training plus a special curriculum. Two projects were presented in the special curriculum: (a) the construction of a miniature farm after visiting a real farm, and (b) planning and constructing a combination flower store and hotel.

The results indicated a trend towards better intellectual growth by the experimental children, although the differences on such small groups were not statistically significant. On the spring Binet at the conclusion of the projects the experimental children averaged 5.3 points higher in IQ than the control children. Form L of the New Revision of the Stanford-Binet, administered the following fall when the children were enrolled in Junior Primary, revealed a difference of 10.1

points in favor of the experimental children. Because of the small number of cases, these results are of course only suggestive.

Gains from preschool attendance appeared to be reflected in school achievement. The school achievement in Grades I to IV of a group of 26 preschool children was compared with that of 31 non-preschool children. These groups represented all available children in the elementary grades who met the following criteria: (a) continuous enrollment in the same school system (School A); (b) an intelligence test at the preschool ages. For the preschool children, the IQ used was the initial one obtained near the time of entrance to preschool. The study was made by Kounin (10).

The two groups were alike in mean IQ at three years of age. Both groups were superior.

<i>Group</i>	<i>N</i>	<i>Mean IQ</i>	<i>S.D.</i>	<i>Mean C.A., Months</i>	<i>S.D.</i>
Non-preschool	31	117.7	16.8	37.0	7.7
Preschool	26	118.3	14.3	40.3	9.5

The range of preschool attendance for the preschool group was 46 to 563 days (median attendance of 193 days).

The mean mark received by the preschool children was significantly higher than the mean mark received by the non-preschool children. Although it cannot be said definitely that the better school achievement of the preschool children was due to their preschool experience, the evidence points in that direction.

2. The Iowa Orphanage Study

A group of non-preschool children of dull-normal and average ability living in an orphanage that made little provision for the mental welfare of the children at these ages decreased markedly in IQ. A similar group of children in the same orphanage, who experienced the same environment, except that they attended preschool for several hours a day, did not show a decrease. The children were studied by Skeels, Updegraff, Wellman, and Williams (17).

This study extended over three years. At the beginning all available children of preschool ages in the orphanage were divided into two groups, a preschool and a non-preschool group. The groups were matched on IQ, age, sex, length of residence in the orphanage, and nutritional status. Over the longest residence period studied (400 or more days) the non-preschool children who initially tested 80 or above in IQ lost 16.2 points, while the preschool children of these initial levels gained 0.5 point. The difference in change was statistically significant. The non-preschool children decreased from a mean of 89.9 to 73.7, or slightly above the division line for feeble-mindedness. The preschool group had at the end a mean within the average ranges (92.1).

400 or More Days' Residence							
<i>Group</i>	<i>N</i>	<i>Mean Days' Residence between Tests</i>	<i>IQ at Beginning of Period</i>	<i>S.D.</i>	<i>IQ at End of Period</i>	<i>S.D.</i>	<i>Change in IQ</i>
Initial IQ 80 and Above							
Preschool	17	540	91.6	8.0	92.1	9.3	+ 0.5
Non-preschool	26	642	89.9	8.4	73.7	13.4	-16.2
Ratio of Diff. in Gain							5.7
Initial IQ 50 to 79							
Preschool	23	612	71.6	4.2	79.3	8.1	+ 7.7
Non-preschool	39	608	68.7	6.8	71.8	9.7	+ 3.1
Ratio of Diff. in Gain							1.8

The non-preschool children initially testing below 80 IQ made a gain of 3.1 points IQ. The preschool children initially at these levels gained 7.7 points. The difference in gains yielded a ratio of 1.8, or 96 chances in 100 of a true superiority for the preschool children.

Within the portion of the non-preschool group testing 80 and above, the decrease in IQ was increasingly greater for the higher IQ levels. The children testing 80 to 89 lost 13.5 points, those testing 90 to 99

lost 17.6 points, and those testing 100 and above lost 28.5 points. The preschool children, on the other hand, who initially tested 80 to 89

<i>IQ Level</i>	<i>Non-preschool</i>		<i>Preschool</i>	
	<i>N</i>	<i>Mean IQ Change</i>	<i>N</i>	<i>Mean IQ Change</i>
100 and above	2	-28.5	2	-4.5
90 to 99	10	-17.6	8	+0.9
80 to 89	14	-13.5	7	+1.6

and 90 to 99 did not change substantially; those testing 100 and above lost 4.5 points.

The changes in the non-preschool group were progressive with increasing length of residence. Over the shortest residence period (mean of 115 days), there was no substantial change for the portion of the group initially testing 80 and above; over the middle residence period (mean 284 days), the loss was 6.6 points; over the longest residence period (642 days), the loss was 16.2 points.

3. Possible Influences of Practice Effects, Coaching, and Test Unreliability

Practice effects do not account for the changes. Several lines of evidence presented in the previous sections militate against practice effects as an explanation of the gains at the preschool ages. These may be summarized briefly as follows:

1. The changes were larger between fall and spring tests than between spring and fall tests, although the intervals were similar.
2. The changes from fall to spring tests were greater when the interval between tests was longer, whereas the reverse should be true with practice effects.
3. Non-preschool children did not increase in mean IQ.
4. Decreases in mean IQ were found in an orphanage population.

Evidence on the second point has not been presented previously. The tabulation on page 391 shows the data on which this conclusion was based.

Coaching does not account for the gains. The preschool laboratories were in operation for several years before analysis revealed that increases in IQ were being obtained. This finding was a discovery rather than the result of a planned experiment. The intelligence measures had been taken routinely for other purposes than to determine the effects of preschool attendance.

During the 17-year period there have been many teachers and assistant teachers in the preschools. Many of these teachers have been unfamiliar with the content of intelligence tests. Yet there has been universality of gains from the first years of the preschool down to more recent years. Such gains have been revealed in both verbal and performance scales.

IQ Level	120 to 179 Days between Tests		180 to 259 Days between Tests	
	Children	Mean Change in IQ	Children	Mean Change in IQ
140 and above	17	- 3.0	12	+ 0.9
120 to 139	62	+ 1.1	59	+ 4.2
110 to 119	46	+ 5.5	55	+ 6.9
90 to 109	43	+ 7.7	66	+ 9.1
Below 90	5	+18.0	5	+14.6

With one exception, no training program has been introduced having as its aim increasing the IQ. This exception was the experiment by McCandless (11), mentioned previously, in which six very superior children served as subjects.

Are tests at the preschool ages reliable and valid? Evidence on *reliability and validity* of IQ's obtained at the preschool ages may be summed up as follows:

1. There was a wide distribution of IQ's, even within a group selected with respect to cultural status of the parents. The range of IQ's in the preschool laboratories was from 80 to 170.
2. Sex differences were small.
3. Gains were made at all ages from fall to spring. Unreliability of a test would interfere with the ability to obtain consistent mean gains.
4. The high levels obtained by the end of preschool were maintained.

5. Correlations between test and retest IQ at the preschool ages fall within the ranges of correlations obtained at the school ages. Fairly high correlations have been obtained at the preschool ages, but low ones have been reported also. This is true at the school ages as well. The median correlation computed by Nemzek (13) from a survey of the literature on children of all ages on the Stanford-Binet was .83. For two groupings of non-preschool children correlations of $.88 \pm .03$ and $.90 \pm .02$ have been obtained. The groups were superior, having mean initial IQ's of 116.6 and 118.4, respectively, at ages 43.2 and 38.8 months. The interval between tests for the first group was 8 to 10 months and for the second group, 14 to 16 months. On the Merrill-Palmer scale a correlation of $.90 \pm .02$ was obtained on retests after an interval of one week. Other correlations have been as low as .60 for preschool children and also for school-age children. One group of school children tested at a mean age of 65.0 months and retested at 109.9 months yielded a correlation of $.63 \pm .05$ (Wellman, Ref. 21).

6. The customary check on validity by means of school achievement is not applicable at the preschool ages. However, the results by Kounin (10) indicated that an IQ obtained at 3 years of age had meaning in terms of school achievement in Grades I to IV, inclusive, since the children testing 120 IQ and above at 3 years made higher school marks than those testing below 120 IQ at 3 years. Also a correlation of $.48 \pm .08$ was obtained by Wellman (22) between IQ at the preschool ages and score on the American Council on Education Test at 15 years of age.

III. MENTAL GROWTH DURING THE ELEMENTARY-SCHOOL YEARS

Preschool children who attended the University Elementary School made additional gains during a four-year period, while a comparable group of preschool children who attended other schools showed no substantial change. Forty-seven pairs were studied by Wellman (21). They were matched in IQ at end of preschool, age at end of preschool, and age on retest. The mean IQ's at 5½ years were 120.5 and 121.0, respectively. Those attending the University Schools gained 5.6 points; those attending the other schools gained 1.2 points.

Did the University School children who were retested represent a selection from the total University School population? From about 1927 on, all children entering the University Schools who had not attended preschool were tested within the first months of school. Since the proportion of children in the first grade who attended preschool is high, any selection of cases for retest reports would fall largely within the group of former preschool children.

In the fall of 1930 there were 8 new (non-preschool) children enrolled in the first grade, and 25 new children enrolled in Grades I to VI. In the fall of 1938 there were 8 new (non-preschool) children enrolled in the first grade, and 25 new children enrolled in Grades I to VI. In the fall of 1938 there were 4 new children in the first grade and 18 new children in the first 6 grades. The mean IQ of children enrolled in the first-grade groups was computed for a 15-year period. The means ranged from 115 to 128.

Brandenburg (4) compared the mental development of preschool children and non-preschool children during their subsequent elementary-school years. Data were available for 114 children who had attended the preschool laboratories of the Iowa Child Welfare Research Station for at least one year and for 58 who had not attended. All these children had an individual mental test at the time of entrance to the first grade of the University Elementary School and at least one test afterward. At the preschool ages the Kuhlmann revision was used under 3½ and the Stanford Revision thereafter. It was found that the entire group of children made a gain of 4 IQ points over a period of 4½ years. This gain was statistically significant. At the age of 10½ years the mean IQ of the children who had attended preschool was slightly higher than the mean for the non-preschool children. A matching of preschool and non-preschool groups on the basis of IQ at the time of entrance to the elementary school showed that the non-preschool children made slightly greater gains than the preschool children.

<i>Attendance in Years</i>	<i>Chil- dren</i>	<i>Age in Months</i>		<i>IQ</i>		<i>Change in IQ</i>
		<i>Initial</i>	<i>Retest</i>	<i>Initial</i>	<i>Retest</i>	
2	48	70.6	98.6	117.1	128.0	+10.9
3	84	69.5	104.8	119.3	126.8	+ 7.5
4	85	69.6	117.2	122.4	124.3	+ 1.9
5 or more	163	70.3	142.2	122.8	124.1	+ 1.3

The peak of gains was reached in two years. The largest mean gain in the University School was made during the first two school years, or from age 6 to age 8. Brandenburg's group attained a mean IQ of 128.0 at this age, having gained 10.9 points since entering first grade. Following that, there was a slight dropping off in mean IQ attained by successive attendance groups. The group retested after an interval of 5 or more years had a mean IQ of 124.1 at 12 years of age. The mean change in IQ for successive attendance groups is shown above.

That this decrease in gain was not a chance phenomenon is indicated by the fact that the same trend was shown for each initial IQ level. The mean changes for each level, exclusive of below average cases, were:

<i>Initial IQ Level</i>	<i>Attendance in Years</i>	<i>Number</i>	<i>Mean Change</i>
Average	2	15	+13.0
	3	22	+12.7
	4	21	+ 9.7
	5 or more	22	+ 8.1
Superior	2	11	+13.3
	3	24	+11.1
	4	15	+ 9.3
	5 or more	50	+ 6.6
Very Superior	2	18	+ 7.2
	3	28	+ 2.3
	4	30	- 1.5
	5 or more	67	- 1.5
Genius	2	3	+ 5.7
	3	10	+ 1.7
	4	16	- 7.1
	5 or more	23	- 9.3

From various analyses presented in previous sections, it is reasonable to conclude that the gains are not explained by practice effects. Evidences against practice effects are: (a) the size of the mean gains, (b) the fact that the children in the lower initial levels made greater gains than the brighter children, and (c) the fact that the gains were not cumulative with longer periods, although such children had taken a greater number of tests.

That there is a decrease in stimulation value of the particular school environment is conjectural. In our present knowledge of the dynamics of environment, the idea of a decrease can be arrived at as an explanation only by the process of elimination of other hypotheses. In any event, the retest means were all high, ranging from 124 to 128.

IV. MENTAL GROWTH FROM PRESCHOOL TO HIGH SCHOOL AND COLLEGE

So far, only one study has been published on the complete sweep from the preschool ages to high-school and college entrance (22). The results from this study indicated that gains in IQ associated with preschool attendance and attendance in the Iowa University School after preschool were meaningful in terms of later development.

Forty-one preschool children and 41 non-preschool children were given the American Council on Education Intelligence Test while enrolled in the high school. The preschool group had a mean IQ of 118 at 52 months of age; the non-preschool group had a mean IQ of 115 at 80 months of age. The mean attendance of both groups in the University Schools (including preschool attendance for the preschool group) was 7 years.

High-school intelligence-test scores were related to length of attendance in the University Schools. The correlation between number of years' attendance and percentile rank on the American Council Test was $.43 \pm .07$ for the 82 cases.

Preschool children made slightly higher Council scores than non-preschool children. Preschool and non-preschool children were matched on initial IQ and number of years' attendance after preschool. The difference yielded a ratio of 1.9, or 97 chances in 100 of a true difference. The respective scores are shown herewith. The mean initial IQ of the preschool group was 117.3, of the non-preschool group 116.8. The mean attendance was, respectively, 6.2 and 6.5 years.

<i>Group</i>	<i>N</i>	<i>Mean Percentile</i>	<i>S.D.</i>	<i>Diff. in Percentile</i>	<i>Ratio</i>
Preschool	29	88.1	16.1	9.8	1.9
Non-preschool	29	78.3	22.3		

College-entrance examination scores were related to length of attendance in the University Schools. Seventy-eight preschool and non-preschool children entered the University of Iowa and were given the usual qualifying examinations administered by the University to entering freshmen. The examinations consist of four parts: the Iowa

High-School Content Examination, the English Training Test of the Iowa placement battery, the Iowa Silent Reading Test, and the Mathematics Aptitude Examination of the Iowa placement battery. A composite score is derived from the four parts.

Twenty-one of the 78 children were preschool children; 57 were non-preschool children. The mean attendance in the University Schools for both groups was 7 years. Long-attendance children (6 or more years in the University Schools) made higher college-entrance scores than short-attendance children (less than 6 years in the University Schools) of the same initial IQ. The respective scores were:

<i>Group</i>	<i>Number</i>	<i>Years' Attendance</i>	<i>Initial IQ</i>	<i>Mean Percentile (Coll. Entr. Exam.)</i>	<i>S.D.</i>
Long Attendance	51	9.7	115.7	80.4	20.8
Short Attendance	27	2.3	116.2	61.4	28.0
Difference		7.4	— .5	19.0	
Ratio of diff. to its S.D.			.1	3.1	

The correlation between years' attendance in the University School and College entrance percentile was $.40 \pm .07$ for the 78 children.

Preschool children made slightly higher scores on the college-entrance examination than did non-preschool children. Preschool and non-preschool children were matched on initial IQ and number of years' attendance after preschool. The respective scores were:

<i>Group</i>	<i>Number</i>	<i>Mean Percentile</i>	<i>S.D.</i>	<i>Differ- ence</i>	<i>Ratio</i>
Preschool	19	83.9	20.3	12.0	1.7
Non-preschool	19	71.9	23.2		

The ratio, 1.7, signifies 96 chances in 100 of a true superiority greater than zero. The mean IQ of the preschool group was 122.8; of the non-preschool group, 120.1. The preschool group had attended 5.6 years; the non-preschool group, 6.1 years.

V. SUMMARY

Published and unpublished studies made at the Iowa Child Welfare Research Station on changes in intelligence associated with conditions of schooling have been summarized briefly in the foregoing pages. The main points brought out are summarized here.

1. Mental Growth during the Preschool Years

1. The principal gains in IQ were made during preschool attendance and not during non-attendance.
2. The gains were cumulative over the first two years of preschool attendance.
3. Non-preschool children did not gain.
4. Correlations between number of days' attendance during one preschool year and change in IQ approached zero.
5. Cultural status of parents did not account for the changes in IQ.
6. An appropriate educational program appeared to affect the IQ change of very superior children.
7. Gains from preschool attendance appeared to be reflected in school achievement.
8. Decreases in IQ were made by non-preschool children in an orphanage.
9. Practice effects do not account for the changes.
10. Coaching does not account for the gains.
11. Tests at the preschool ages are fairly reliable and valid.

2. Mental Growth during the Elementary-School Years

1. The pattern of change varied with different elementary schools.
2. Gains were made in the University School by non-preschool children; slightly less gain by preschool children.
3. The peak of gains was reached in two years.
4. Practice effects do not account for the gains.

3. Mental Growth from Preschool to High School
and College

1. High-school intelligence-test scores were related to length of attendance in the University Schools.
2. Preschool children made higher scores on the high-school test than did non-preschool children.
3. College-entrance examination scores were related to length of attendance in the University Schools.
4. Preschool children made higher scores on the college-entrance examination than did non-preschool children.

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CHAPTER XXVII

A GENETIC STUDY OF FIFTY GIFTED CHILDREN

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The development and use of the intelligence test has increased greatly our knowledge of the nature and extent of individual differences; it has also deepened and enriched our understanding of the special needs and true potentialities of various mental deviates. Perhaps the most significant contribution from the varied research is the increased knowledge concerning gifted children. The work has led educators to recognize a new and important responsibility for extending and enriching educational opportunities; and it has tended to correct many faulty notions and beliefs concerning gifted children—among them, the widespread belief in the peculiarity or eccentricity of exceptionally gifted or talented persons.

My studies made in the Middle West offer support to Lewis M. Terman's work and reveal the status and needs of gifted children in a section of the United States not encompassed by other investigations. I have studied 50 gifted children for a period beginning in 1924-1925 and continuing to the present year. In this chapter I shall set forth a brief summary of the children's developmental status in 1924-1925, 1930-1931, and in 1934-1935, when data were secured and analyzed.

Most of the 50 children were identified by use of mental tests given the entire school population of Grades III to VII in Kansas City, Missouri. All children whose ratings placed them above the 99th percentile on the National Intelligence Test were given the Stanford-Binet examination, and 41 of IQ 140 and above were thereby located. Nine were added from neighboring school systems in three Kansas towns. Analysis of the frequency of gifted children in these school populations shows that one may expect to find 3 to 5 such

children in every sample of 1000 youngsters in the elementary school. They are usually the youngest in their groups and almost invariably the most successful on objective measures of educational attainment.

At the time of their identification, the average chronological age of the group was 10 years, 5 months. There were 26 boys and 24 girls. Two children could not be found for reëxamination in 1929-1930, and 3 of the original group were unavailable in 1933-34. Substitutions were made in order that comparative data could be presented for 50 children at the three periods. The substitutes were of the same age, sex, race, general family background, and IQ as the children whom they replaced. Data were obtained also for a control group (IQ 90 to 110) paired with the gifted according to sex, age, and race.

In 1924-1925, data were procured for each child by use of the following:

1. National Intelligence Test, Scales A and B, Form 1
2. Stanford Revision of the Binet-Simon Intelligence Test
3. Stanford Achievement Examination, Advanced, Form A
4. Overstatement tests
5. A test of play interests and activities
6. Physical measures and records of physical development
7. Home information forms
8. Extensive school histories and records

During the month of April, 1929, and May, 1933, follow-up investigations included study of the children in the following respects:

1. Physical development and health
2. School record
3. General information
 - a. Social and moral traits
 - b. Activities in and out of school
 - c. Abilities, talents, and interests
 - d. Future plans

Data were secured for both gifted and control groups in 1930-1931, while in 1933-1934, information was obtained only for the gifted children. The following conditions are briefly summarized: family background, physical development, intelligence, educational achievement, and social characteristics.

I. FAMILY BACKGROUND

The racial stock included a preponderance of English, Scotch, German, and Jewish ancestors. Ninety-six percent of the parents

were American born. There was no nervous instability in the immediate families of these children.

Of the fathers, 64 percent were business men; 34 percent, professional men. The average yearly income of the fathers in 1924-1925 was \$3,300, while the average yearly income of the fathers of the control group was \$2,000.

Many of the parents held positions of honor, such as executive, political, religious, and military offices of distinction. Among the more distant relatives of the children were many distinguished and honored patriots and statesmen of the United States. Moreover, many of the gifted group were direct descendants of noted educators, clergymen, physicians, scientists, authors, musicians, and dramatists.

Of the parents, 50 percent were college-trained men and women. The mean amount of formal education of the fathers was 13 years; of the mothers 12 years.

II. PHYSICAL DEVELOPMENT

It has frequently been assumed erroneously that gifted children are physically deficient or retarded. The data in this study support those of other investigators in refuting this common belief. The following height and weight tables obtained from the first and second studies are convincing evidence at this point:

HEIGHT OF GIFTED CHILDREN COMPARED WITH NORMS
(Percent Distribution)

<i>Comparison with Standard</i>	<i>Second Study</i>		<i>First Study</i>	
	<i>Boys</i>	<i>Girls</i>	<i>Boys</i>	<i>Girls</i>
Normal (within 2 in.)	62	56	59	50
Above normal	22	30	16	27.2
Below normal	16	14	25	22.7

WEIGHT OF GIFTED CHILDREN COMPARED WITH NORMS
(Percent Distribution)

<i>Comparison with Standard</i>	<i>Second Study</i>		<i>First Study</i>	
	<i>Boys</i>	<i>Girls</i>	<i>Boys</i>	<i>Girls</i>
Normal (within 10 lb.)	61	70	85	65
Above normal	20	15	10	10
Below normal	19	15	5	25

The developmental histories showed that the mean weight of these children at birth was somewhat greater than the norm; and 90 percent were said to have had good or excellent health during their first year of life. The average age for walking was 13 months; and the use of short sentences occurred at an average age of 11.3 months. Thus, general superiority characterized the very early development of this group. The superiority in health was maintained, as the following tabulation shows.

GENERAL HEALTH (Percent Distribution)						
<i>Health</i>	<i>Third Study</i>		<i>Second Study</i>		<i>First Study</i>	
	<i>Boys</i>	<i>Girls</i>	<i>Boys</i>	<i>Girls</i>	<i>Boys</i>	<i>Girls</i>
Good	80	88	82	90	84	96
Fair	17	8	13	8	10	3
Poor	3	4	3	2	6	1

At the time of the first study, 68 percent of the gifted reached or exceeded the median of the control group in a general health index, while at the time of the second study, 65 percent of the gifted reached or exceeded the norm in this respect. At the time of the third study, the gifted group exceeded averages in measures of physical development and health status.

III. INTELLIGENCE

At the time of the first study the intelligence quotients of the children ranged from 140 to 183, mean 153. Group-intelligence-test scores were assembled for the children in the second study. These tests yielded a mean IQ of 136, with a range of 121 to 180. The group tests are, of course, relatively unreliable; however, the general ranking of the children was similar in the two studies. The coefficient of correlation is .66 between the scores of the children on the Stanford-Binet of 1924 and the Terman Group Test results for 1929. In 1934-1935 group intelligence tests were again given. Analyses of the scores show that all the group would fall among the upper 5 percent of college students. These results confirm the observation that those who will be highly gifted in college and in high school can be identified with con-

siderable accuracy by intelligence tests administered when they are still children in the elementary school.

IV. EDUCATIONAL ACHIEVEMENT

The gifted children were not noticeably unsymmetrical in their educational development. Superiority in all academic work characterized them. In the elementary school their best work was accomplished in reading and in language endeavor, and their poorest in handwriting and in spelling. Nevertheless, they exceeded the norms for children of their ages in *all* subjects. Few of the boys and a small number only of the girls displayed extraordinary literary talent in the secondary school, and an exceptionally small number appeared to be talented in music.

Precocity in certain types of language development, however, was revealed in childhood. For example, Lawrence, a gifted boy of ten, defined words as follows: "*Flaunt*, means to show or display with intent to show; *Mars* is a planet, the God of War, also a verb."

The Stanford Achievement Test, Form A, was given to the entire group. The average subject quotients are presented below:

<i>Subject</i>	<i>Subject Quotient</i>	<i>Subject</i>	<i>Subject Quotient</i>
Reading 1	144	Nature study and science	137
Reading 2	142	History and literature	133
Reading 3	142	Spelling	131
Arithmetic 1	135		
Arithmetic 2	134		

The sixth-grade group *exceeded January averages* for eighth-grade children in the composite results of the tests, and the composite score of the seventh-grade group *exceeded ninth-grade standards*. The children appear to have a knowledge of educational subject matter *at least two years in excess of their grade placement*.

The typical gifted child in this study never repeats a grade, nor does he skip more than four half-grades. The mean progress quotient in 1925 was 116. The typical child was therefore accelerated 16 percent of his age beyond the age norm of his classmates. The mean IQ, how-

ever, is 153 and the mean EQ is 136. The difference between the mean progress quotient and the mean intelligence quotient is 37 points.

Standard tests were not given in the second or third studies. Grades were secured, and the teachers were asked to rate the children in their various subjects. With the exception of one boy who was ranked as average, the mean scholastic rank of every child is markedly above average. There was a slight difference in the mean rank for the sexes; the teachers' rating for the quality of the work of the boys was slightly below that of the girls. In the second study, English and foreign languages were the subjects best liked by both boys and girls. This shows a continuation of language interests reported in the first study.

Two children only received extra promotions during the interval between the first and the second studies. These skipped one half-grade. According to age-grade norms, no child was retarded in school progress at the time of the second study, when the mean progress quotient for the group was 112.

At the time of the third study, the majority of the young people were in college. Almost half of the marks of the boys and 70 percent of the girls' marks were A. Not a single failing mark was received by a girl; two were assigned the boys. The marks of the 30 percent who have graduated were distinctly above average. Five girls and two boys among the graduates are married. There is no unemployment in the group who are not in college.

Over 50 percent of the gifted must earn half or more of their expenses in order to attend college. One may logically question whether this is the most profitable manner in which this group may spend their time. And in view of their unusual capacity and potentiality, one may question the character and propriety of the typical college offering for this group. The answer to the first question is clear. It would seem a desirable social investment if scholarships were provided *all* these young people whose educational attainment and ability make it almost certain that they would gain measurably by such an opportunity. How unfortunate that 8 of these young people have had to abandon their aspirations to complete college because of economic necessity.

The second need involves the development of curricula that will give opportunity for the full expression of the capacities of the most gifted persons enrolled in college. There are many data to make one doubt whether this need is now being met in the rapidly growing

American college. Thus, some studies show that the overlapping educational attainment, objectively measured, is so great that about 20 percent of the sophomores and 15 percent of the freshmen reach or exceed the median score of seniors in certain colleges. Moreover, Terman stresses the fact that, among 49 colleges recently studied by Leonard and Wood, the 75th percentile upon the Carnegie tests is lower in some colleges than the 25th percentile in others. And sensibly, he proposes that we "quit accrediting colleges and credit instead the individual student."¹

The consequences of the 'credit' system are far-reaching; the harm is perhaps greatest in the case of the gifted child who becomes progressively less well cared for as he proceeds through our schools.

It is not my purpose here to suggest an educational program for the gifted. But the inadequacy of the present educational opportunity is so glaringly apparent at every level that no one informed about the situation can fail to register his protest.

V. SOCIAL CHARACTERISTICS

In measures and estimates of character development, the gifted group was distinctly superior at the time of the first study. They were superior also in nervous poise and stability.

In the first investigation, data regarding the development of social and moral traits were obtained from two objective tests and from teachers' ratings of character, while in the second, teachers' ratings only were utilized.

It appeared that the gifted children had not lost in sociability and adaptability in the time between the two studies. In the second study, no child was reported as being avoided by other children; only one was so reported in the first study. And no child was thought to be decidedly queer. Two serious disciplinary problems were reported in the second study, and several children were considered 'difficult to manage.'

In the second study the teachers were asked to judge play interests. Of the children being considered, 94 percent were said to be 'normal' in their play; only three children were reported to play less than the average amount.

Further study of the children corroborated the teachers' judgment. Gifted children were observed to turn somewhat more frequently than

¹Terman, L. M. "The gifted student and his academic environment." *School and Soc.*, 49: 1939, 65-73.

the average children to sedentary and relatively quiet plays and games. This was brought about in part by the gifted child's unusual interest in reading. In spite of this tendency, gifted children engage in approximately the same number of play activities and games as do average children. Special recognition was won somewhat more frequently by the gifted than by the control group.

At the time of the third study, 10 of the gifted children, 7 boys and 3 girls, appeared to be maladjusted, 3 decidedly so. All had previously reached or exceeded medians for children of their ages upon character tests. The 10 maladjusted fall into two general types: (a) the withdrawn, who display anxiety feelings and marked insecurity, and (b) the indifferent, socially inadequate, bored dilettantes who understand life's issues but refuse to participate in them. Beyond doubt the school has had an important rôle in creating the dilettantes, for the 5 boys and the 2 girls in this group have never been interested in striving, because success came so easily during the elementary school and disillusion so quickly during the social-economic crisis that has attended their adolescent development.

VI. SUMMARY¹

Some of the outstanding characteristics of the gifted group follow.

1. The gifted group ($n = 50$) have IQ's 140 to 183. There are 26 boys and 24 girls. The mean IQ of the entire group is 153; the means for the boys and the girls fall in the same interval, 150 to 155.

2. The physical status and general growth of the group are undoubtedly above average. Typically the gifted child is not a physical weakling. He is found to be somewhat above normal in his physical development when he is compared with unselected children of the same chronological age. He approaches the norms for the average child in physical traits and motor dexterity.

¹The reader will find in his Yearbook files (not to mention numerous other sources) original investigations and summaries of earlier studies of the gifted child, including an extended bibliography; see, for example, *The Nineteenth Yearbook, Part II, 1920*, "Classroom Problems in the Education of Gifted Children," by T. S. Henry, and *The Twenty-Third Yearbook, Part I, 1924*, "The Education of Gifted Children," by a Committee of the Society. The fact that many of the recommendations here made so cogently by Professor Witty appear in substantially similar form in these volumes of the Society published fifteen to nineteen years ago is evidence that, in this phase of education, administrative practice has made virtually no progress in implementing the seemingly unequivocal factual and theoretical outcomes of scientific investigation.—*Editor*.

3. The gifted child is apparently well adjusted to school life. This was clear in his 'liking' academic work, in his ready participation in varied activities, and in the favorable attitude of classmates toward him. The adequate physical development, vigorous health, and manual superiority of the gifted are important factors in facilitating desirable adjustment in school.

4. There is a marked excess of English, Scotch, and Jewish stock represented. The ancestry of the children holds numerous scientists, statesmen, educators, and writers of note.

5. Most of the children have had the advantages of stimulating cultural influences in the home. The average amount of formal education of the parents is 13 years; the average income of the parents is \$3,300, and in most of the homes, newspapers, magazines, and books are abundant. The fathers of the gifted group are engaged in business and professional pursuits mainly, and are considerably above the average of their various occupational groups in financial success.

6. At the time of the first study, the mean IQ of the group was 153; the mean EQ, 136; and the progress quotient, 116. The unjustifiable educational retardation suggests the failure of the present school organization to provide adequate stimulation for the gifted child. The excess in educational achievement above the norm is *general* rather than special. Moreover, it persists as the children mature.

7. The interests of the children reflect their general superiority. Versatility and vitality of interest characterize them. The children engage in the same number of play activities as the control group, though the gifted are somewhat more solitary and sedentary in their play.

8. In ratings of character and in scores on objective tests, the typical gifted child surpasses the average child in the control group.

9. Follow-up data covering ten years show that the gifted child has maintained his superior mental ability.

10. The average progress quotient of the group in 1929-1930 was 112; at the time of the first study, it was 116. The school apparently is making little effort to provide educational opportunity for this group. Acceleration, which has been urged by some educators, is not frequently practiced.

11. In spite of the failure of the school to experiment with the group or to provide enriched school experience, the gifted child maintains his high level in general information and in general academic attainment.

12. Failure to respond well to discipline increased during the interval between examinations, and the boys were decidedly worse offenders than the girls. Maladjustment also increased.

13. The rather superior social adjustment of the gifted children is maintained. They participate generously in school life and receive school honors more frequently than the control group at every academic level.

CONSTITUTION OF THE NATIONAL SOCIETY FOR THE STUDY OF EDUCATION

(As Revised at the 1924 Meeting and Amended in 1926, 1928, 1929, 1932, and 1933)

Article I

Name. The name of this Society shall be "The National Society for the Study of Education."

Article II

Object. Its purposes are to carry on the investigation of educational problems, to publish the results, and to promote their discussion.

Article III

Membership. Section 1. There shall be two classes of members—active and honorary.

Section 2. Any person who is desirous of promoting the purposes of this Society is eligible to active membership and shall become such on payment of dues as prescribed.

Section 3. Active members shall be entitled to vote, to participate in discussion, and, under certain conditions, to hold office.

Section 4. Honorary members shall be entitled to all the privileges of active members, with the exception of voting and holding office, and shall be exempt from the payment of dues.

A person may be elected to honorary membership by vote of the Society on nomination by the Board of Directors.

Section 5. The names of the active and honorary members shall be printed in the Yearbook.

Section 6. The annual dues for active members shall be \$2.50. The election fee for active members shall be \$1.00.

Article IV

Officers. Section 1. The Officers of the Society shall be a Board of Directors, a Council, and a Secretary-Treasurer.

Section 2. The Board of Directors shall consist of six members of the Society and the Secretary-Treasurer. Only active members who have contributed to the Yearbooks shall be eligible to serve as directors, and no member who, under the provisions of Section 3, has been elected for two full terms in immediate succession shall be eligible to reelection to succeed himself for a third term.

Section 3. The Board of Directors shall be elected by the Society to serve for three years, beginning on March first after their election. Two members of the Board shall be elected annually (and such additional members as may be necessary to fill vacancies that may have arisen).

CONSTITUTION

This election shall be conducted by an annual mail ballot of all active members of the Society. A primary ballot shall be secured in October, in which the active members shall nominate from a list of members eligible to said Board. The names of the six persons receiving the highest number of votes on this primary ballot shall be submitted in November for a second ballot for the election of the two members of the Board. The two persons (or more in the case of special vacancies) then receiving the highest number of votes shall be declared elected.

Section 4. The Board of Directors shall have general charge of the work of the Society, shall appoint its own Chairman, shall appoint the Secretary-Treasurer, and the members of the Council. It shall have power to fill vacancies within its membership, until a successor shall be elected as prescribed in Section 3.

Section 5. The Council shall consist of the Board of Directors, the chairmen of the Society's Yearbook and Research Committees, and such other active members of the Society as the Board of Directors may appoint from time to time.

Section 6. The function of the Council shall be to further the objects of the Society by assisting the Board of Directors in planning and carrying forward the educational undertakings of the Society.

Article V

Publications. The Society shall publish *The Yearbook of the National Society for the Study of Education* and such supplements as the Board of Directors may provide for.

Article VI

Meetings. The Society shall hold its annual meetings at the time and place of the American Association of School Administrators of the National Education Association. Other meetings may be held when authorized by the Society or by the Board of Directors.

Article VII

Amendments. Proposals to amend this Constitution may be made by the Board of Directors or by petition of twenty-five or more active members of the Society. Such proposals shall be submitted to all active members for a mail vote, and shall be declared adopted if approved by two-thirds of the members voting thereon.

MINUTES OF THE CLEVELAND MEETING OF THE SOCIETY

February 25 and 27, 1939

The first session of the Society was held in the Music Hall of the Public Auditorium and was a joint meeting with the American Educational Research Association. The large auditorium was well occupied on the main floor and the public address system permitted everyone of the audience of some 1200 persons to hear without effort.

FIRST SESSION—SATURDAY EVENING, FEBRUARY 25, 1939, 8:00 P.M.

Professor Frank N. Freeman, Chairman of the Board of Directors of the Society, presided. The discussion was devoted to the Thirty-Eighth Yearbook of the Society, Part I, entitled "Child Development and the Curriculum," that had been prepared by a committee of the Society under the chairmanship of Superintendent Carleton Washburne.

The five speakers and their topics were as follows:

I. "The Purpose and Viewpoint of the Yearbook."

CARLETON WASHBURN, Superintendent of Schools, Winnetka, Illinois, and Chairman of the Society's Committee. (15 minutes)

II. "The Relation of Child Development to Education."

JOHN E. ANDERSON, Director of the Institute of Child Welfare and Professor of Psychology, University of Minnesota, Minneapolis, Minnesota. (15 minutes)

III. "Typical Research Relating the Curriculum to Child Development."

LEO J. BRUECKNER, Professor of Elementary Education, University of Minnesota, Minneapolis, Minnesota. (15 minutes)

IV. "The Relation of Emotional Development to the Planning of the Curriculum."

JOHN WASHBURN, Associate Professor of Education, Syracuse University, Syracuse, New York. (12 minutes)

V. "The Significance of the Yearbook."

ERNEST O. MELBY, Dean of the School of Education, Northwestern University, Evanston, Illinois. (12 minutes)

There was some informal discussion, participated in particularly by John Washburne, and Messrs. Anderson, Melby, and Carleton Washburne, of the speakers.

SECOND SESSION—MONDAY AFTERNOON, FEBRUARY 27, 1939, 2:15 P.M.

This meeting was a joint session with the National Society of College Teachers of Education. It brought together at the Old Stone Church some 200 persons to listen to a discussion of the Thirty-Eighth Yearbook of our Society, Part II, entitled, "General Education in the American College." This Yearbook had been prepared by a committee of the Society under the chairmanship of Professor Alvin C. Eurich.

Dean M. R. Trabue, member of the Board of Directors of this Society and President of the National Society of College Teachers of Education, as presiding officer, presented the speakers and topics. The program was carried out as follows, save that the address of President Wriston, who was unable to be present, was read by Professor F. N. Freeman.

I. "Introducing the Yearbook."

ALVIN C. EURICH, Professor of Education, Stanford University; Director of Curriculum, Menlo School and Junior College, Palo Alto, California; and Chairman of the Society's Committee. (15 minutes)

II. "Discovering Needs for General Education."

MALCOLM S. MACLEAN, Director of the General College, University of Minnesota, Minneapolis, Minnesota. (15 minutes)

III. "General Education in Arts Colleges."

HENRY M. WRISTON, President, Brown University, Providence, Rhode Island. (15 minutes)

IV. "General Education and Teacher Education."

KARL W. BIGELOW, Director of the Commission on Teacher Education, American Council on Education, Washington, D.C. (15 minutes)

V. "General Education in Universities."

A. J. BRUMBAUGH, Dean of the College and Professor of Education, University of Chicago, Chicago, Illinois. (15 minutes)

VI. "A Forward Look."

ROBERT LEIGH, President, Bennington College, Bennington, Vermont. (15 minutes)

VII. Informal Discussion.

Open to members of the two organizations. (4 minutes each)

GUY M. WHIPPLE, *Secretary*.

SYNOPSIS OF THE PROCEEDINGS OF THE BOARD OF DIRECTORS OF THE SOCIETY DURING 1939

This synopsis, indicating matters of importance only that have been considered by the Board of Directors, is presented in order that the members of the Society may be informed concerning the acts and policies of those who are directing the work of the Society.

I.

CLEVELAND MEETING OF THE BOARD OF DIRECTORS

Cleveland, Ohio: Hotel Cleveland, February 26 and 28, 1939.

Present: Brueckner, Freeman (Chairman), Goodykoontz, Horn, Trabue, Tyler, Whipple; part of the time, Director-elect Kefauver; and by invitation for short periods, Professors S. R. Powers and Ira C. Davis; Dean George Stoddard; Professor A. C. Eurich; and Dr. P. B. Jacobson, of Chicago.

Present: (Second, adjourned session): Brueckner, Freeman, Goodykoontz, Horn, Tyler, Whipple; part of the time, Kefauver.

1. The Secretary reported as a result of the ballot in December, 1938, the election of Professor W. C. Bagley, Columbia University, and Dean Grayson N. Kefauver, of Stanford University, to serve for three years beginning March 1, 1939.

2. The Secretary reported that the resolutions on the death of Dean M. E. Haggerty had been published in the October, 1938, issue of the *Journal of Educational Research*, and in Part II of the *Thirty-Eighth Yearbook* of the Society, and that a copy had been sent to Mrs. Haggerty.

3. An inventory of the Society's stock of yearbooks in the warehouse of the publishers showed a list value of \$49,457.52. In view of an overstock in the case of certain issues, the Secretary was directed, in conference with the publishers, to arrange for a special offering of these issues to members of the Society at reduced rates. [This offer was made to each member of the Society in December, 1939.]

4. The Board, by correspondence, made a third appropriation for the Washburne committee of \$210.00 to cover expenses that had not been anticipated by this committee.

5. Permission was granted for offprinting more than the 200 copies regularly permitted of Chapter XVI of the *Thirty-Eighth Yearbook*, provided Superintendent Washburne met certain stipulations with respect to their distribution, particularly that none of the offprints should be sold either directly or indirectly at a profit.

6. The appropriation made to Professor Eurich to aid in the production of the Yearbook sponsored by him was augmented by an extra appropriation of \$20.77 to cover unforeseen, but reasonable, expenses.

7. Miss Bess Goodykoontz was elected Chairman of the Board of Directors for one year beginning March 1, 1939.

8. Director Tyler and Dean Trabue were appointed representatives of this Society on the Council of the A.A.A.S. at its December, 1939, meeting at Columbus.

9. Mr. Ralph P. Bridgman, of the National Council of Parent Education, withdrew his proposal for a Yearbook on "Parent and Family Education."

10. Dean George Stoddard reported the status of the Yearbook on "Intelligence."

11. Mr. Thomas Munro, Chairman of the Society's Committee on "Art Education," reported progress on his Yearbook, which promises to be of very considerable interest to the educational public.

12. Two proposals were placed before the Board for a Yearbook on "General Education in the Secondary Field." One proposal was presented by Professor Eurich and Dean Kefauver; another by Dr. P. B. Jacobson and Professor Freeman. At the suggestion of the Board the four persons just mentioned conferred among themselves to see whether some joint or intermediary plan of attack upon the problem could be arranged. The result of the conference being that a combination seemed difficult and unprofitable, and an elaborate study from another source being scheduled for appearance shortly, it was voted that the two proposals before the Board should be laid on the table.

13. A statement from Director-elect Bagley was read in which he suggested that a comparative treatment of the philosophical systems underlying present-day educational theories would be welcomed by many educators. After extended discussion of the possible content of such a yearbook and of the best approach to be followed, it was voted to appropriate \$250.00 to defray the expenses of an advisory committee to consider the suggestions, including the reactions of several of the Board of Directors and to report at a subsequent meeting.

14. The sum of \$250.00 was also appropriated to defray the expenses of a similar advisory committee, operating under the chairmanship of Professor Freeman, to report upon the feasibility of a companion Yearbook on the "Psychological Theories Underlying Present-day Education."

15. Supt. Leonard B. Wheat proposed a Yearbook on "Ungraded Primary Schools." Further discussion of this proposal was deferred until the next meeting of the Board.

16. Discussion of the foregoing yearbook topics led to a decision that, for long-term planning, it might be profitable to solicit information from a considerable number of members of the Society for topics upon which they would welcome the sort of information that the Society might assemble in yearbooks. Subsequently this canvass was undertaken and a surprisingly large number of topics was mentioned.

17. Professors S. R. Powers and Ira Davis presented personally a request that the Board sponsor as a publication of the Society a report on the teaching of science. This proposal was followed by extended discussion that brought out four or five rather serious difficulties in the situation, including its place in our publication schedule, the nature of the interrelations between this Society and certain other organizations, and the extent and nature of the jurisdiction of the Society over the contents and organization of the proposed yearbook. This led eventually to a decision that the Society reject the proposal to bring out a Yearbook on "The Teaching of Science."

18. There was considered the desirability of affiliation with the American Council on Education. Action was deferred until information about certain points not clear to the Board could be secured.

19. It was voted that in view of its being practically obligatory for the Directors to attend the annual dinners given by the Society to the Yearbook Committee and speakers on the Society's programs, the Society should likewise pay the expenses of the Directors on these occasions.

20. To facilitate consideration of proposed yearbooks it was voted that the proposers should submit in writing at least five weeks in advance of the Board meeting a fairly comprehensive statement of the contents, purpose, mode of approach, and possible contributors of the yearbooks proposed. The Secretary has prepared a suitable form on which such statements are to be submitted.

II.

CHICAGO MEETING OF THE BOARD

Chicago, Illinois: Hotel Stevens, September 8.

Present: Bagley, Brueckner, Goodykoontz, Horn, Kefauver, Whipple.

Absent: Tyler.

1. Attention was called to the possibility of obtaining associate membership, instead of constituent membership, in the American Council of Education, and the Secretary was instructed to investigate the possibility of such associate membership at an annual fee not exceeding \$10.00, with the expectation that the Society would join on that basis.

2. The question of the format of the yearbooks having been previously raised, it was decided in the light of conferences with the publishers and others

that no charge should be made, save that in future Yearbooks the table of contents was to be expanded by including subheads in each chapter sufficiently specific to serve in lieu of an index.

3. Attention was called by the Chairman and the Secretary to quotations from one of the Society's yearbooks that had appeared in a certain book on school practices without permission of the Society and without any reference to the source or to the fact that the material was quoted. The author of the book in question and his publishers having proposed a method of making reparation for this infringement of copyright, it was voted that the method they proposed be accepted as a satisfactory solution to the situation.

4. The Secretary was requested to ascertain the conditions and cost of incorporation of the Society and to report thereon to the Board of Directors.

5. The status of the Yearbook on "Intelligence" and of that on "Art Education" was reviewed and discussed. One outcome of the discussion was the suggestion by Director Bagley that the certification of teachers would be an excellent topic for a yearbook.

6. Consideration of the St. Louis program found the Board disposed to hold two sessions, the first of which, on Saturday evening, should be a joint session with the American Educational Research Association. There was extended discussion of the tentative program submitted by Chairman Stoddard, which led to the laying out of a revised program somewhat differently organized. This revised program was later fully endorsed by Chairman Stoddard.

7. Director Bagley was encouraged to proceed with the plan of assembling an advisory group for a discussion of the Yearbook he had proposed upon the "Philosophical Principles of Education" and to report the outcome at the February, 1940, meeting of the Board.

8. Dr. Freeman's committee deputed to consider the feasibility of a Yearbook on the "Psychological Principles of Education" reported that it seemed unadvisable to undertake so important a yearbook in view of the very careful and probably lengthy consideration that would have to be given to such a topic. What amounts to a minority report favoring this topic for a yearbook was received later in the form of an outline and list of possible committee members made by Professor T. R. McConnell, of the University of Minnesota. Consequently this topic is still before the Board.

9. Dean David G. Ryan, of William Woods College, Fulton, Missouri, proposed a Yearbook dealing with "Motivation" and suggested possible contributors. Action on this proposal was deferred until it had been decided whether a yearbook should be prepared on the "Psychological Principles of Education."

10. Dr. Harold Jones, of the University of California, submitted a comprehensive proposal for a Yearbook on "Adolescence," to appear in 1945. This proposal is still under consideration.

11. An inventory of topics proposed for yearbooks that had been secured by the solicitation of some 200 members of the Society selected by chance was presented by Chairman Goodykoontz. The 273 topics forthcoming from 120 replies and arranged in 14 main divisions revealed such a wealth of suggestions as to necessitate more leisurely and careful consideration of the whole program of publication, and will consequently be a subject for subsequent meetings of the Board of Directors.

GUY M. WHIPPLE, *Secretary*.

REPORT OF THE TREASURER OF THE SOCIETY
Condensed Statement of Receipts and Expenditures for the Year
July 1, 1938 – June 30, 1939

Balance on Hand, July 1, 1938..... \$20,706.15

RECEIPTS

From Sale of Yearbooks	\$12,328 05
From Fees for Quotations	11.00
From Dues	3,072.50
From Interest and Exchange of Securities	934 92
Total Receipts for the Year	16,346 47
Total Receipts, including Initial Balance	\$37,052.62

EXPENDITURES

For Manufacturing and Distribution of Yearbooks	\$ 7,213 31
For Preparation by Committees	3,614.20
For Reprinting	627.20
For Board and Society Meetings	288.23
For Editorial, Secretarial, and Clerical Services	2,860.95
For Supplies, Stationery, Printing, Postage, Rent	511.13
For Bonding, Auditing, Telegrams, Refunds, etc.	80.34
For Interest Bought and Exchanging Six Bonds	210.06
Total Expenses for the Year	\$15,405.42
Balance on Hand June 30, 1939	21,647.20
Total Expenses and Closing Balance	\$37,052.62

BALANCE ON HAND, JUNE 30, 1939

Cash:

Checking Accounts (Two Banks)	\$4,354.92
Savings Accounts (Four Banks)	6,892.89
	<u>\$11,247.81</u>

Securities:

Bonds and Stocks at Cost Value	10,399.39
Balance, June 30, 1939	<u>\$21,647.20</u>

GUY M. WHIPPLE, *Treasurer*

MEMBERS OF THE NATIONAL SOCIETY FOR THE STUDY OF EDUCATION

(This list includes all persons enrolled Dec. 31, 1939, whether for
1939 or 1940)

HONORARY MEMBERS

Dewey, Emeritus Professor John, Columbia University, New York, N. Y.
Hanus, Professor Paul H., Harvard University, Cambridge, Mass.
Holmes, Manfred J., Illinois State Normal University, Normal, Ill.

ACTIVE MEMBERS

Abelson, Dr. Harold H., College of the City of New York, New York, N. Y.
Abernethy, Professor Ethel M., Queens College, Charlotte, N. C.
Acharlu, K. S., Head Master, District Normal School, Tumkur, Mysore, India.
Adams, Miss Ruby M., Director of Elementary Education, Schenectady, N. Y.
Adams, Mrs. W. R., University of Vermont, Burlington, Vt.
Adkins, Stanley, Superintendent of Schools, Ely, Minn.
Aitken, E. S., Supervisor, Rapides Parish Schools, Alexandria, La.
Alexander, Professor Carter, Teachers College, Columbia Univ., New York, N. Y.
Alger, John L., President, Rhode Island College of Education, Providence, R. I.
Allen, C. F., School Administration Building, Little Rock, Ark.
Allen, Miss Clara B., 145 East Maple Ave., Ottumwa, Iowa.
Allen, I. M., Superintendent of Schools, Highland Park, Mich.
Allen, Richard D., Dir., R.I. Inst. Counseling & Personnel Service, Providence, R. I.
Allman, H. B., Superintendent of Schools, Muncie, Ind.
Andersen, C. T., Assistant Director of Research, Public Schools, Detroit, Mich.
Anderson, Evans, Waldorf College, Forest City, Iowa.
Anderson, Harold A., School of Education, University of Chicago, Chicago, Ill.
Anderson, Homer W., Superintendent of Schools, Omaha, Neb.
Anderson, Professor Howard R., Grad. School of Educ., Cornell Univ., Ithaca, N. Y.
Anderson, John E., Dir., Inst. Child Welfare, Univ. of Minn., Minneapolis, Minn.
Anderson, Miss Marion, Ginn and Company, Boston, Mass.
Anderson, Professor Roy N., Teachers College, Columbia Univ., New York, N. Y.
Andrews, Miss Elizabeth M., Prin., Bancroft School, Washington, D. C.
Andrus, Dr. Ruth, State Department of Education, Albany, N. Y.
Ansbaugh, G. E., Principal, Bryant School, Chicago, Ill.
Antell, Henry, 118 Montague Street, Brooklyn, N. Y.
Anthony, Miss Katherine M., Dir. of Training, Madison Coll., Harrisonburg, Va.
Archer, Professor C. P., University of Minnesota, Minneapolis, Minn.
Armstrong, Miss Sara M., State Normal School, Framingham Centre, Mass.
Arsenian, Professor Seth, Springfield College, Springfield, Mass.
Asgis, Dr. Alfred J., 33 West 42nd St., New York, N. Y.
Ashbaugh, Professor E. J., Miami University, Oxford, Ohio.
Atkins, Miss Helen L., Dean of Girls, Manual Training H. S., Denver, Colo.

- Atkins, Dr. Ruth E., 217 Normal Avenue, Normal, Ill.
Augustin, Miss Eloise D., State Normal School, Oneonta, N. Y.
Avery, F. B., 197 East Post Road, White Plains, N. Y.
Avery, George T., State Agricultural College, Fort Collins, Colo.
Ayer, Miss Jean Y., Box J, Essex, Conn.
- Babcock, E. H., Superintendent of Schools, Grand Haven, Mich.
Babcock, George T., 182 Second St., San Francisco, Calif.
Backus, Professor Joyce, State College, San Jose, Calif.
Bader, Miss Edith M., Assistant Superintendent, Ann Arbor, Mich.
Bagley, Professor William C., Teachers College, Columbia Univ., New York, N. Y.
Bailey, D. L., Western Illinois State Teachers College, Macomb, Ill.
Bailey, Francis L., 99½ College Street, Montpelier, Vermont.
Baker, Miss Edith M., Acting Librarian, Clark University, Worcester, Mass.
Baker, Miss Edna Dean, Pres., National College of Education, Evanston, Ill.
Baker, H. Leigh, Dean, College of Education, Drake University, Des Moines, Iowa.
Baker, Harold V., Prin., Daniel Webster School, New Rochelle, N. Y.
Baker, Dr. Harry J., Director, Psychological Clinic, Public Schools, Detroit, Mich.
Baker, Ira Y., County Superintendent, Court House, Gettysburg, Penn.
Ballou, Frank W., Superintendent of Schools, Washington, D. C.
Ballou, Richard Boyd, Dept. of Education, Smith College, Northampton, Mass.
Balyeat, Professor F. A., University of Oklahoma, Norman, Okla.
Barber, Fred H., Box 247, Emory, Virginia.
Bardy, Joseph, Bellerich Apts., 15th and Spruce Sts., Philadelphia, Penn.
Bare, J. M., Principal, Birchwood High School, Birchwood, Tenn.
Barget, Carl W., 14 Winthrop Place, Maplewood, N. J.
Barrett, Rev. John I., S. E. Cor. Franklin and Cathedral Streets, Baltimore, Md.
Barth, Rev. Pius J., Dean of Education, Quincy College, Quincy, Ill.
Bartlett, Roland O., Prin., Noranda High School, Noranda, Quebec, Canada.
Batchelder, Miss Mildred L., Amer. Library Assoc., 520 N. Mich. Ave., Chicago, Ill.
Beall, Professor Ross H., University of Tulsa, Tulsa, Okla.
Bear, Professor Robert M., Dartmouth College, Hanover, N. H.
Beattie, Alfred W., Superv. Prin., Ben Avon Public School, Pittsburgh, Penn.
Beaumont, Miss Florence, Prin., P.S. 150, Long Island City, N. Y.
Beck, Professor Hubert Park, University of Minnesota, Minneapolis, Minn.
Bedell, Professor Ralph, University of Nebraska, Lincoln, Neb.
Bednar, Miss Christine, 633 Blackstone Avenue, Chicago, Ill.
Behrens, Professor Minnie, State Teachers College, Huntsville, Texas.
Bell, Dr. J. Carleton, 1032A Sterling Place, Brooklyn, N. Y.
Bemiller, J. F., Galion, Ohio.
Bemis, E. O., Jr., Prin., School No. 3, Ecorse, Mich.
Bender, John F., School of Education, University of Oklahoma, Norman, Okla.
Benner, Thomas E., Dean, College of Education, University of Illinois, Urbana, Ill.
Bennett, Miss Margaret E., Director of Guidance, Public Schools, Pasadena, Calif.
Benson, Dr. C. E., New York University, Washington Square, New York, N.Y.
Benson, J. R., 6131 Magnolia Avenue, St. Louis, Mo.
Benz, H. E., College of Education, Ohio University, Athens, Ohio.
Berg, Selmer H., Superintendent of Schools, Rockford, Ill.
Bergman, W. G., Director of Instructional Research, Detroit, Mich.
Berry, Professor Charles S., Ohio State University, Columbus, Ohio.

- Betts, Professor Emmett A., Pennsylvania State College, State College, Penn.
Beust, Miss Elsa, Editor-in-Chief, Charles E. Merrill Co., New York, N. Y.
Bigelow, Karl W., American Council on Education, Washington, D. C.
Billett, Professor Roy O., Boston University, Boston, Mass.
Billig, Dr. Florence G., College of Education, Wayne University, Detroit, Mich.
Bishop, Fred G., Superintendent of Schools, Two Rivers, Wis.
Bixler, H. H., Dir., Research and Guidance, Board of Education, Atlanta, Ga.
Bixler, Professor Lorin, Muskingum College, New Concord, Ohio.
Blackburn, J. Albert, Rutgers University, New Brunswick, N. J.
Blair, Dr. Glenn M., University of Illinois, Urbana, Ill.
Boardman, Professor Charles W., University of Minnesota, Minneapolis, Minn.
Boggan, T. K., Superintendent of Schools, Picayune, Miss.
Boggs, Miss Emily E., Hunter College High School, New York, N. Y.
Bolton, Professor Frederick E., University of Washington, Seattle, Wash.
Bond, Austin D., c/o J. S. Redway, Adams, N. Y.
Bond, Professor Guy L., University of Minnesota, Minneapolis, Minn.
Bontrager, O. R., Asst. Dir. Student Teaching, State Teachers Col., California, Penn.
Booras, Julius, St. Olaf College, Northfield, Minn.
Bossing, Professor Nelson L., University of Minnesota, Minneapolis, Minn.
Bowersox, Fred C., County Superintendent of Schools, Clinton, Iowa.
Bowman, Clyde A., Dir., Dept. Industrial Arts, Stout Institute, Menomonie, Wis.
Bowyer, Vernon, WPA Education, 228 N. LaSalle St., Chicago, Ill.
Boyce, Arthur Clifton, 156 Fifth Ave., New York, N. Y.
Boyd, Fred, 416 North Limestone, Lexington, Ky.
Boyer, Philip A., Dir., Division of Educational Research, Philadelphia, Penn.
Boyles, R. E., Principal, Washington High School, Washington, Penn.
Bracken, J., 7500 Maryland Avenue, Clayton, Mo.
Bradner, J. W., Superintendent of Schools, Middlesboro, Ky.
Bragdon, Miss Helen D., Hood College, Frederick, Md.
Branom, Frederick K., Chicago Normal College, Chicago, Ill.
Breckinridge, Miss Elizabeth, Principal, Louisville Normal School, Louisville, Ky.
Breed, Professor Frederick S., 1224 East Fifty-seventh Street, Chicago, Ill.
Bresnahan, Dr. Ella L., Dir., Dept. Educ. Investigation and Meas., Boston, Mass.
Brewer, Professor John M., Harvard University, Cambridge, Mass.
Bridges, Miss Mabel L., Elem. School, State Normal School, River Falls, Wis.
Bridgett, Miss Alice E., Colony Street School, R.F.D. 1, Wallingford, Conn.
Bridgman, Ralph P., 126 Old Post Road, Croton, N. Y.
Briggs, Dr. Thomas H., Teachers College, Columbia University, New York, N. Y.
Bright, Ira J., Superintendent of Schools, Leavenworth, Kan.
Bright, O. T., Jr., Superintendent of Schools, Flossmoor, Ill.
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INFORMATION CONCERNING THE NATIONAL SOCIETY FOR THE STUDY OF EDUCATION

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2. **ELIGIBILITY TO MEMBERSHIP.** Any person who is interested in receiving its publications may become a member by sending to the Secretary-Treasurer information concerning name, title, and address, and a check for \$3.50 (see Item 5).

Membership is not transferable; it is limited to individuals, and may not be held by libraries, schools, or other institutions, either directly or indirectly.

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